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PRINCIPAL CONTENTS

Technical : PAGE

Founding of Magnesium, by E. F. Emley, Ph.D., B.Sc., F.R.I.C., F.I.M.: The first section of the Paper, printed in this week's issue, deals with casting alloys, preliminary considerations in melting and refining, preparation of melts, and pouring procedure 33

Scandinavian Foundry Review: The Editor's own account of visits to two foundries in Sweden, beginning a series of articles comprising a survey of the foundry industry of the host countries for this year's International Foundry Congress . . 41

Features :

Leader: BCIRA and the Small Founder . 31
Law Cases 50
Equipment and Supplies 52
Notes from the Branches 55

Commercial :

Company News 51
Raw Material Markets 58
Current Prices of Iron, Steel and Non-ferrous Metals 60

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BCIRA and the Small Founder

Whilst there was a splendid attendance at the "open day" organized by the British Cast Iron Research Association to inspect the laboratories at Alvechurch, yet we are not satisfied that there was adequate representation from the smaller foundry concerns. This is regrettable, as an immense amount of trouble had been taken to make the work of the various laboratories crystal-clear to those who could read, and interpret diagrams. Admittedly, some of the apparatus, such as the Quantometer or a plant for rapidly raising the surface of rammed sand to very high temperatures, is complicated, but it will quickly be realized that the former is just a new instrument for the rapid analysing of alloys; whilst the latter is used for finding out just what happens to sand when it is suddenly heated up, as it would be by the impact of molten metal.

Some small-foundry owners may think that because some years ago they visited Alvechurch, a second visit is a waste of time. They little realize that a research organization to continue in existence must be dynamic, not static. Last week, for example, a new melting shop was opened. Some like ourselves were a little startled to read in the programme that there was no mention of a cupola installation in the laboratories. Then from the president's (Mr. J. J. Sheehan) address when opening it, we learnt that a very special cupola plant is to be installed. It will have hot-blast attachments, water-cooled tuyeres, full instrumentation, and removable sections. This is good news, but we hope that the initial tests will be made with cold blast, ordinary tuyeres, and normal running, to establish exactly just what improvements can be made when using the newer concepts. Then there is a newly-equipped shop carrying, in fan-shaped fashion, about half-a-dozen machines for testing the creep properties of cast iron. The information derived will be of the greatest assistance for makers and users of diesel-engine components. Here, the test-pieces will be loaded for long periods until fracture takes place, under conditions which can be related to those existing in practice.

Finally, addressing ourselves again to the smaller foundry owners, we would remind them that they, too, pay the proportionate quota for the operation of these well-staffed, magnificently-equipped laboratories and that membership is free for the mere formality of filling up a form. Moreover, though the "open days" for 1957 have passed, they can visit the laboratories by appointment and learn by the best possible method—inspection—how they can undoubtedly benefit from its activities and services. The staff are not just "back-room" boys, but are as familiar with the intricacies of the foundry industry as the foundry owner himself.

G

BSCRA Annual General Meeting

The fourth annual general meeting of the British Steel Castings Research Association was held in London on July 3, with Mr. C. H. Kain (Lake & Elliot, Limited) in the chair. At the meeting Mr. J. Currie (Blackett, Hutton & Company, Limited); Dr. R. Hunter (Clyde Alloy Steel Company, Limited); Mr. James Jackson (Jackson Elphick & Company, Limited); and Mr. R. J. Richardson (Brown, Lenox & Company, Limited); were re-elected to the Council, and additional members of Council elected were the Rt. Hon. the Lord Clydesmuir M.B.E. (Steel Company of Scotland, Limited); Mr. E. W. Colbeck (Hadfields, Limited); Mr. R. F. Horton (Osborn Foundry & Engineering Company, Limited); and Mr. J. Mowat (William Beardmore & Company, Limited).

The annual report which was adopted at the meeting records the continuing growth of the membership of the Association and announces that the constitution has been amended, so as to permit those engaged in the production and marketing of materials, machinery etc., used in the steelfounding industry to be admitted to membership of the Association as associate members. Summaries of progress in 25 research projects are included in the report, and those of interest to founders will be published in a future issue of this JOURNAL.

IBF Golf Meeting

The annual golf meeting of the Institute of British Foundrymen will be held this year at Royal St. David's Golf Course, Harlech, from September 28 to 29. Arrangements have been made for members to be accommodated at St. David's Hotel, Harlech, and those who wish to book direct should write to Miss Sutcliffe, manageress, and refer to the IBF golf meeting when making the booking. Members of the Society are advised to send their annual subscriptions to the secretary of the IBF Golfing Society, Mr. G. W. Nicholls, c/o Modern Foundries Limited, Albert Road, Halifax.

Air Control 21st Anniversary

Air Control Installations, Limited, which has its headquarters at Ruislip, Middlesex, this year celebrated its twenty-first anniversary. Since its establishment, it has been constantly expanding and to-day, a 15,000 sq. ft. extension is approaching completion. The works were toured by representatives of the Press and friends. Amongst the shops visited was the foundry, which is devoted to the production of die-castings for their own use. Here, it was interesting to see that they "took their own medicine" for the crucible furnace was fitted with an Air Control "Fumegard," which effectively prevented any emission of fume into the shop. It was noticed when touring the shops a number of "Dusgard" attachments were being made, this is the apparatus designed by the British Cast Iron Research Association for the suppression of dust from stand grinders. The firm has a block of well-equipped laboratories—a prerequisite for the intelligent handling of problems they are called upon to solve. The firm now employs about 565 people who enjoy the benefits of a good canteen and other social services. The firm is an excellent example of a modern engineering and sheet-metal works.

Dinner

WORSHIPFUL COMPANY OF FOUNDERS

The Ladies' Dinner, of the Worshipful Company of Founders, was held last Thursday at the Haberdashers' Hall, the Master, Major L. E. Cotterell, presiding. Toasts were proposed by Lord Rathcreedan, Mr. C. H. Kain and the Clerk, Mr. Wilson Wiley, the responses offered by Mrs. L. E. Cotterell and the Master. The stewards were Mr. R. C. Scott and Mr. R. B. Templeton. The company was entertained by Susan Longfield and Patrick Halstead with Audrey Kitchener as accompanist.

Mr. H. F. CLEMENTS has been appointed a director of William Jacks & Company, Limited.

ORIGIN of BRASS ?

Mr. Harmar Nichols, M.P., Parliamentary Secretary to the Ministry of Works, unveiled a plaque at Tintern Abbey recently, which commemorated the diamond jubilee of the National Brassfoundry Association. The plaque bears the inscription: "Near this place, in the year 1568, brass was first made by alloying copper with zinc." In the right-hand picture are (left to right), Mr. A. Wilson, president of the Association, Mr. Harmar Nichols, Mr. J. D. Southerton, past-president, and Mr. E. N. Hiley, national secretary.

Founding of Magnesium*

By E. F. Emley, Ph.D., B.Sc., F.R.I.C., F.I.M.

During recent years, designers have realized the value of magnesium-alloy castings, the "old wives' tales" of the metal's inflammability and lack of corrosion resistance having been put into perspective. Expanding use of magnesium in industrial engineering has resulted in the development of a larger range of alloys, together with improvements in existing compositions. This Paper details numerous aspects of the founding of magnesium, under the following headings:—Casting-alloys; melting and refining; preparation of melts; pouring; sand casting—dealing with moulding sand, cores and chills, mould preparation and running and feeding—; casting features of certain alloys; cleaning; inspection and surface treatments; repair of castings; gravity- and pressure-die-casting; miscellaneous casting methods, and concludes with advantages and typical applications of magnesium-alloy castings. In the first section printed in this issue; the subject is taken as far as pouring procedures recommended. It is explained how founding procedures are adapted to the metal's physical and chemical properties; comparisons are made between magnesium and some other metals, and a comprehensive list of alloys is tabulated.

Dr. Edward F. Emley is chief metallurgist of Magnesium Elektron Limited, Clifton Junction, Manchester. He joined the company 15 years ago after seven years in the lead industry. He was educated at the Royal Grammar School, Newcastle-upon-Tyne, and obtained the degrees of B.Sc. and Ph.D. of London University as an external student. Papers from his pen on various aspects of magnesium technology and also on astronomy have been published; his other interests include music, mountaineering, and colour photography. Dr. Emley is a Fellow of the Royal Institute of Chemistry and of the Institution of Metallurgists.

Introduction

Magnesium is the lightest constructional metal, and weldable pressure-tight alloys of the metal are available, which can readily be cast into complex shapes and which provide higher strength-to-weight ratios in the cast state than can be obtained with aluminium or iron. The ease with which magnesium can be machined is remarkable, and for this reason the final costs of commercial magnesium-alloy castings on a volume basis often compare favourably with those in other metals. At one time, magnesium alloys were widely supposed to be corrodable and inflammable, but actually the unprotected alloys stand up to normal industrial atmospheres rather better than does mild steel, and very satisfactory protective treatments, including sealing of the surface with epoxy resins, are now available when required. As for inflammability, except in the form of powder or fine swarf, magnesium will not ignite until the melting point has been exceeded (Fig. 1). Production of magnesium castings in this country runs into thousands of tons each year; whilst, as regards quality, "in no metal have commercial castings of greater complexity been cast to higher quality standards than in magnesium alloys."[1]

The procedures used in the founding of magnesium are adapted to its physical and chemical properties (Table I and Fig. 2) and so differ in certain aspects from those employed with other metals. In particular, the low density of the metal results in there being relatively little hydrostatic pressure to fill thin sections and resist "blows"; the chemical reactivity necessitates the use of special fluxes in melting, moulding sand of high permeability and low moisture content, with inhibitors added, and a sulphur atmosphere during pouring, whilst the low-volume heat-content presents problems in running and feeding. The choice of possible flux constituents is severely limited by the chemical affinity of magnesium for oxygen, and the fluxes used are of necessity based on thermally stable halides of the most electropositive metals including those of magnesium itself.

It will be seen therefore that in magnesium founding, technology, chemistry, metallurgy and the founder's art all have their place. In the present Paper little will be said concerning the control of quality of magnesium-alloy castings, since this forms the subject of a paper[2] discussed at the Spring Meeting (1957) of the Institute of Metals.

Casting Alloys

Magnesium casting alloys fall into two groups according to whether they contain aluminium or zirconium. Aluminium refines the grain of magnesium, thereby increasing tensile properties, and forms the basis of the well known Mg/Al/Zn/Mn alloys, A8 and AZ91† Such alloys can be further grain-refined by the old "superheating" process in which melts are held for a period at temperatures over 850 deg. C., or by the more recent carbon-inoculation processes. The manganese offsets the

* This article is based on a lecture given to a meeting of the London section of the Institute of Metals, last session, to which London foundrymen were invited as guests.

† For general information, see reference [11]; constitutional diagrams[12]; and metallography[13-14].

FIG. 1.—*Lack of fire risk with magnesium—letters melted out of* 16 *s.w.g. magnesium sheet with an oxyacetylene welding torch without igniting the metal*!

adverse effect on corrosion resistance which small amounts of iron present would otherwise exert. These alloys have a freezing range in practice of nearly 200 deg. C. and show some tendency to exhibit porosity in the form of intergranular microshrinkage, especially where feeding is inadequate. This tendency is accentuated, particularly in thick sections of castings, if appreciable amounts of gas are present in the melt. For full development of tensile properties, high temperature solution heat-treatments are involved, and the fully heat-treated alloy (AZ91) exhibits low ductility.

Zirconium is only soluble in liquid magnesium to the extent of 0.6 to 0.7 per cent., but its presence exerts a strong grain-refining effect*. The resultant single-phase alloy possesses high ductility and can be stiffened by additions of certain permissible elements to give alloys possessing desirable properties. Thus, addition of zinc yields the high-strength alloy Z5Z which, in common with the other high-strength zirconium alloys, requires only a medium temperature precipitation treatment to develop full tensile properties, and possesses satisfactory ductility†. Further addition of rare-earth metals (mischmetal‡) gives the virtually pressure-tight weldable alloy, RZ5, exhibiting only slightly lower properties, whilst thorium addition gives a similar alloy, TZ6, with even higher properties than Z5Z.

Rare-earth metals and thorium confer elevated temperature creep-resistance on magnesium alloys and, in conjunction with zirconium, give rise to alloys such as ZRE1 and ZT1 for use at temperatures up to 250 deg. C. and nearly 350 deg. C. respectively. These two alloys exhibit freezing ranges of under 100 deg. C. with good feeding characteristics, and as a result, are resistant to cracking, weldable, and completely pressure-tight. Some properties of the magnesium casting alloys are given in Tables II and III. It is interesting to note that nearly three quarters of the magnesium alloys used in aircraft applications are now of the zirconium type.

MELTING AND REFINING

Preliminary Considerations

Magnesium is extracted by both electrolytic and thermal processes and the raw metal produced contains oxide and, in the former case, residual cell electrolyte§. Breakdown of the air-formed oxide film on solid magnesium occurs above about 500 deg. C. and at higher temperatures, a non-protective oxide-scale develops. The molten alloys oxidize relatively slowly near the melting point, but at temperatures above about 850 deg. C., a freshly-exposed surface immediately bursts into flame. Unlike the case of aluminium, oxide films on molten magnesium have little protective effect, and in fact, the presence of oxide initially accelerates the oxidation process. Formation of some nitride‖ can occur, particularly if the oxygen supply is restricted. The use of suitable fluxes or inert atmospheres is therefore essential in melting and handling the molten metal.

Fluxes are of two main kinds; namely, the thinly fluid, " protective " or Z-type, and the so-called inspissated (thickened) " refining "¶ or E-type. The former usually consist of $MgCl_2$ with KCl or NaCl added to reduce the melting point and minimize hydrolysis of the $MgCl_2$, whilst the latter contain the same constituents (forming the *protective base* of the flux) together with inspissating agents

TABLE I.—*Comparative Physical Properties of Magnesium and Some Other Metals.*

	Mg.	Al.	Cu.	Zn.	Ni.	Fe.
Melting point (deg. C.) ..	650	660	1,083	420	1,453	1,537
Boiling point (deg. C.) ..	1,103	2,480	2,590	907	3,000	3,070
Density (grammes per c.c.) ..	1.74	2.70	8.96	7.14	8.9	7.87
Coefficient of expansion × 10^6..	26.0	23.5	17.0	31	13.3	12.1
Thermal cond. cgs. units	0.40	0.57	0.94	0.27	0.21	0.17
Specific heat ..	0.25	0.22	0.09	0.09	0.11	0.11
Volume heat cap. (cal. per c.c.) ..	0.43	0.58	0.81	0.64	0.96	0.85
Latent heat of fusion per unit volume (cal. per c.c.)	150	250	440	190	650	560

such as CaF_2 and MgO which stiffen up the protective base until the flux is capable of forming a coherent pasty viscous cover on the metal surface, which can be readily drawn aside and will " stay put " when the metal is cast[5]. Before the invention of inspissated fluxes, fluid protective fluxes such as $KCl,MgCl_2$ (anhydrous carnallite) were alone used and considerable trouble was encountered with flux inclusions in castings. On exposure to air, such inclusions absorbed moisture by virtue of their

* For a comprehensive bibliography on Mg/Zr alloys, see F. Sauerwald.[3] For the Mg/Zr constitutional diagram, see Mellor[10] and accompanying discussion.

† Zirconium raises the solidus of the Mg/Zn alloys very considerably, thereby suppressing the tendencies to heavy microporosity and cracking shown by the binary alloys with zinc.

‡ Mischmetal is a commercial mixture of the cerium group of rare-earth metals and contains roughly 50 per cent. Ce and 25 per cent. La, the balance being mainly neodymium and praeseodymium.

§ The electrolyte has the following approximate composition: $CaCl_2$ 40, NaCl 30, KCl 20, $MgCl_2$ 10 per cent.

‖ Both oxide and nitride are insoluble in magnesium, any solubility of the former not exceeding about 0.005 per cent.

¶ It should be noted that thinly fluid fluxes are widely used in the USA for refining non-zirconium alloys, and that, in consequence, they are sometimes referred to as " refining fluxes " in American literature. The term " refining " will be used throughout to indicate the step of stirring the metal under a cover of flux whereby the risk of non-metallic inclusions is minimized. For American fluxing technique, see Nelson.[4]

TABLE II.—*Designations, Compositions, and Tensile Properties of Magnesium-base Casting Alloys.*

Alloy type.	Designation (US equivalents in parentheses)A	Specification.	Typical chemical composition, per cent.						Tensile tons per sq. in.B		Descriptive remarks.D
			Al.	Zn.	Mn.	Zr.	Rare-earth metals.	Th.	0.1% stress, proofC	Ultimate stress,	Elongation % on 2 in.
High-strength Zirconium	Z5Z (ZK51) As-cast	DTD. 711A	—	4.5	—	0.7	—	—	7.0– 8.5	13.0–17.0	7–15	High proof stress structural alloy.
	Heat-treated	DTD. 721A							8.5–10.5	15.0–18.0	5–12	Non-weldable.
	RZ5 (ZE41) As-cast	DTD 738	—	4.0	—	0.7	1.2	—	5.5– 6.5	11.0–12.0	3– 6	Almost porosity-free.
	Heat-treated	DTD 748	—	4.0	—	0.7	1.2	—	8.0– 9.0	13.0–14.5	3– 5	Resistant to cracking.
	TZ6 (ZH62) As-cast	DTD 000 (Draft M40)	—	5.5	—	0.7	—	1.8	9.5–11.0	17.0–19.5	5–15	Strongest alloy.
	Heat-treated											Almost porosity-free
												Crack-resistant.
High-temperature Zirconium	ZRE1 (EZ33) As-cast and annealed	DTD. 708	—	2.2	—	0.6	2.7	—	5.0– 6.0	9.0–11.0	3– 6	For use up to 250 deg. C. Excellent castability. Completely pressure-tight. Crack-resistant.
	MCZ (EK31) As-cast and annealed	DTD. 728	—	—	—	0.6	3.0	—	5.0– 6.0	9.0–10.5	3– 6	
	ZT1 (HZ32) Heat-treated	DTD. 5005	—	2.2	—	0.7	—	3.0	5.0– 6.0	12.0–14.0	5–10	For use up to nearly 350 deg. C. Completely pressure-tight. Crack-resistant.
Standard Aluminium-containing	A8 (AZ81) As-cast	BS. L121 (Aircraft) ..	8.0	0.5	0.3	—	—	—	4.5– 5.5	9.0–11.0	2– 5	General-purpose alloy.
	Solution-treated	BS. 1277 (Gen. Eng.)							4.5– 5.5	13.0–17.0	6–15	Good shock-resistance as solution-treated.
		BS. L122 (Aircraft)										
		BS. 1278 (Gen. Eng.)										
	A8 (high purity) As-cast	DTD. 684	8.0	0.5	0.3	—	—	—	As for A8.			Enhanced corrosion-resistance.
	Solution-treated	DTD. 690							4.5– 6.0	8.0–10.5	1– 3	General-purpose alloy for intricate castings.
	As-cast	BS. L123 (Aircraft) ..										
		BS. 1273 (Gen. Eng.)							5.0– 6.0	13.0–16.0	4– 8	
	Solution-treated	BS. L124 (Aircraft) ..	9.5	0.5	0.3	—	—	—				
		BS. 1274 (Gen. Eng.)							6.5– 8.5	13.0–16.5	1– 4	Low ductility when fully heat-treated.
	AZ91E Fully heat-treated	BS. L125 (Aircraft) ..										
		BS. 1275 (Gen. Eng.)							4.0– 5.5	8.0–11.0	2– 5	
	As-cast	—	7.5–9.5	0.3–1.5	0.15 (min.)	—	—	—	4.0— 5.5	12.0–16.0	4–10	General-purpose alloy for commercial applications.
	Solution-treated	—										
	C Fully heat-treated	—							5.0– 7.5	13.0–16.0	1– 3	

A Suffixes denoting state, etc., are omitted.

B In the range given for tensile properties, the lower figure is usually the specification minimum.

C Proof stress by "offset" method.

D *Note.*—Except where otherwise stated, all the alloys can be welded by the argon-arc process.

E AZ91 is also available in a high-purity grade.

The tonnage figures are long tons of 2,240 lb; to convert to kg. per sq. mm., multiply by 1.575.

deliquescent nature, with consequent development of unsightly local corrosion spots. With modern fluxes, very little care is required to avoid flux inclusions, and their occurrence in well-run foundries is very rare. In carrying out the fluxing processes, melting may be performed with a Z-type flux, after which an E-type flux is used for a rotary refining step and subsequently, as a cover during pouring; or an all-purpose E-type flux of slightly greater fluidity may be used throughout. The latter is the normal procedure with the zirconium alloys for which special high-density fluxes are required.

Owing to the position of the magnesium in the electrochemical series (Fig. 2), very few impurities can be removed from the metal by fluxing or drossing.* On the other hand, elements which are expensive in the metallic state can often be alloyed more cheaply with magnesium, by adding them in the form of their compounds. Thus, zirconium can be introduced into magnesium by reactions of the following type.†

$$ZrF_4 + 2Mg = 2MgF_2 + Zr$$

Melts are made in cast or fabricated steel crucibles holding from 50 to 600 lb. metal. The crucibles should be washed and examined at regular intervals and discarded in good time when wearing thin, since a magnesium run-out can be dangerous.‡ Furnaces should be kept free from iron scale and porous siliceous brick must be avoided in their construction. Molten magnesium reacts violently with moisture, and the consequent need for thorough preheating to redness of all tools before insertion in metals is accentuated by the deliquescent nature of any adherent flux.

In what follows it is assumed that analysed ingot and founders own scrap§ only are

* Some exceptions are Ba, Ca, Na, Li and Th.

† In this case, other salts must be added with the ZrF_4 to flux away the MgF_2 formed.

‡ For safety precautions, see Hirst[24] (*Mag. Rev. and Abs.* 1944 **4**, 14.)

§ American practice is frequently to melt in larger crucibles, *e.g.*, 1,000 to 2,000-lb. capacity under a protective flux, and to pour off into smaller crucibles from which the castings are poured. Only inspissated fluxes are used in the smaller crucibles.

Founding of Magnesium

used. No alloying additions will then be required in the case of the aluminium-type alloys, but revivification of the zirconium contents of all zirconium alloys will be needed,* and allowance must be made for small losses or rare-earth metals and thorium in processing, where these elements are present in the alloys.

Preparation of Magnesium/Aluminium Alloy Melts†

A little flux is sprinkled around the sides and the bottom of the crucible, and the metal charged to the crucible. Scrap should be cleaned from adherent sand, preferably by shotblasting. When melting is about to begin, flux is sprinkled over the charge, and subsequently added as required in order to prevent or check oxidation. Once melting is

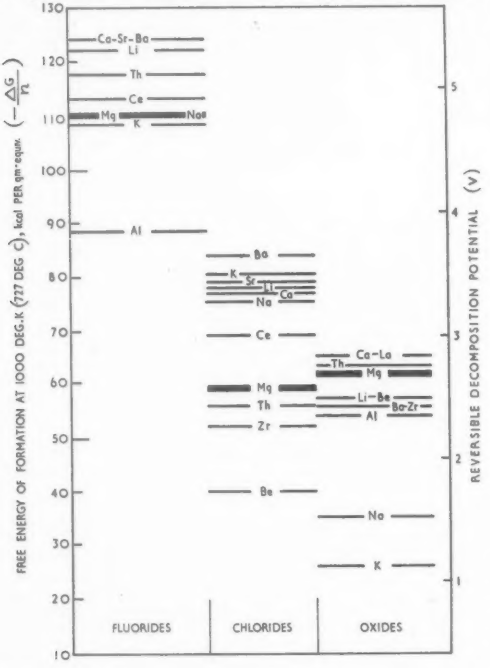


FIG. 2.—*Comparative stabilities of oxides and halides of magnesium and some other metals: Stability increases from bottom to top of diagram. (Data taken from Ref.*[33]*—E. F. Emley,* CHEM. ENG. SCI., 1952, **1**, 131).

complete, the metal surface is covered with flux‡ and the temperature raised to about 750 deg. C. The melt is now ready for degassing§ grain refinement and refining. Two representative procedures for carrying out these steps follow: The first is most usual in this country whilst the second is used by some companies in the USA.

Degassing and Carbon-grain Refinement‖ with Hexachlorethane

By plunging 0.025 to 0.1 per cent. hexachlorethane, hexachlorbenzene, etc., into the melt, any excess gas can be conveniently removed, and at the same time, the melt is innoculated with carbon so that the resulting castings are fine grained. The hexachlorethane may conveniently be contained in a diving bell or plunger with peg attached, to ensure that it is kept in the metal, clear of the flux residue at the bottom of the crucible. When gaseous evolution has ceased, the bell is removed, a fresh flux-cover applied, and the melt stirred with a vigorous rotary motion for about a minute. This is the normal rotary flux-refining process applied to magnesium alloys and its main functions are to absorb, or immobilize oxide and residual melting flux or cell electrolyte, so as to leave a clean body in the metal in the crucible, the bottom and sides of which become coated with a sticky flux layer.† After stirring, the metal surface is covered with a thick layer of flux which quickly melts, forming after a few minutes a coherent viscous cake. This excludes air effectively so long as the metal is undisturbed, and can readily be drawn away from the crucible lip before casting.

TABLE III.—*Approximate Solidification Data on Magnesium Casting Alloys.*

Alloy.	Solidus in absence of zirconium, deg. C.	Solidus,A deg. C.	Liquidus, deg. C.	Average casting shrinkage, per cent.
Z5Z ..	530B	550 (570)C	640	1.3
RZ5 ..	—	—	—	1.3
TZ6 ..	—	500	630	1.3
ZRE1 ..	—	545	640	1.55
MCZ ..	—	580	600	1.3
ZT1 ..	—	550	647	1.55
A8 ..	420	470	600	1.2
AZ91 ..	420	470	595	1.2
C	420	470	600	1.2

A Determined by thermal arrest in cooling curve, and, in the case of the zirconium alloys, probably corresponding to a lower dissolved zirconium-content than that present in castings.

B The non-equilibrium solidus in the absence of zirconium is probably about 350 deg. C.

C Probable true solidus based on wrought-alloy investigations.

Chlorination followed by Superheating

Bubbling chlorine through the melt at about 750 deg. C. is more effective for degassing than are fully-chlorinated hydrocarbons such as hexachlorethane. A little $MgCl_2$ is produced during chlorination and this, together with the stirring action of

* Zirconium-alloy ingots are supplied with relatively-low zirconium contents and the balance of the zirconium must be added by the founder. Some zirconium is always lost on remelting scrap, so that revivification of zirconium is always required, and in practice, the same zirconium addition is made by the founder to all his melts, irrespective of the proportions of ingot and scrap in the charge.

† For more detailed consideration of fluxes and fluxing procedure, see refs. [5, 6]. Ref. [3] calls attention to points of detail which can affect quality of castings.

‡ From this stage onwards, an inspissated flux only will be used.

§ Degassing is always desirable where castings with thick sections are to be poured, but its omission will have little effect in other cases so long as clean ingot and scrap have been used. Dirty or corroded scrap may, however, introduce objectionable amounts of gas resulting in accentuated microporosity in castings.

‖ The carbon grain refining processes are covered by British Patents Nos. 606,948 and 608,941-2.

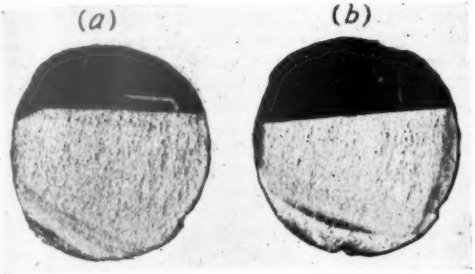


FIG. 3.—*Fractured 1-in. dia. chill bars in binary magnesium/zirconium alloy, showing (a) "marginal" and (b) "good" grain sizes corresponding to 0.5 and 0.6 per cent. dissolved zirconium respectively.*

the chlorine, effects refining of the melt so far as oxide is concerned. No trouble is encountered with flux inclusions arising from the fluid $MgCl_2$ if the flux refining is then omitted, providing of course that a cover of inspissated flux is applied to the metal surface when chlorination ceases. This flux absorbs $MgCl_2$ on the surface of the melt and forms the usual viscous cover.

In carrying out chlorination, the gas is usually led into the melt through a carbon tube and this can effect a certain amount of grain refinement. The process may, however, be followed by the classical super-heating treatment, in which case the melt temperature is raised above 850 deg. C. for a period before cooling to pouring temperature. Production of A8-type alloy in high-purity grade (DTD 684, 690) requires that the high-purity alloy charge should be melted in "seasoned"* crucibles, and grain refined and cast without delay. Grain refinement is by carbon inoculation and temperatures are kept as low as practicable to minimize iron pick-up.

Preparation of Zirconium-alloy Melts

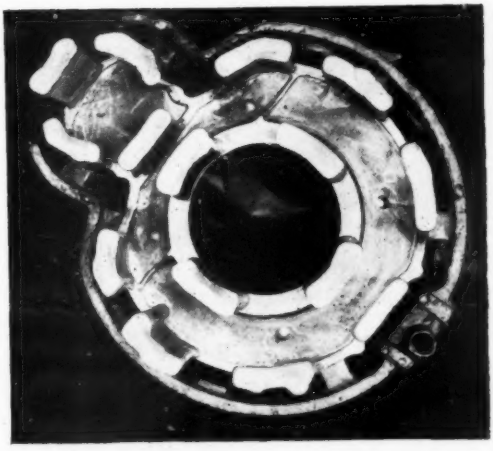
Some peculiarities of zirconium alloys should first be mentioned. Only the zirconium which is soluble in the liquid alloys contributes to grain refinement and the enhancement of mechanical properties. On the other hand, zirconium is insoluble in magnesium if small amounts of elements such as Al, Si, Fe, Mn and H are present. To alloy zirconium effectively, it is therefore necessary to add sufficient to precipitate all such impurities and in addition, to provide an excess which can dissolve in the melt as required to maintain saturation. The latter is necessary because a number of factors tend to precipitate zirconium from the molten alloy, *e.g.* slow pick-up of iron from the crucible, hydrogen from reaction with moist air, entry of traces of aluminium, etc., into the alloy as a result of reduction by the magnesium of traces of their compounds present as impurities in the fluxes used, etc. Precipitated particles of zirconium alloyed with these interfering elements accumulate at the bottom of the melt, and for this reason, a portion of each melt (*e.g.*, one tenth to one fifth, depending on crucible size and pouring speed) should be left unpoured. This, however, can be cast into ingot and added to other melts.

Because of the presence of some (metallographically) insoluble zirconium-rich particles in samples taken for chemical analysis, it is difficult to determine by analysis the true effective zirconium-content of a melt.† However, a very good guide is easily obtained by casting a 1-in. dia. chill bar and examining the fracture (Fig. 3), this being a reflection of the grain size. In fact, the grain size of a test sample cast under standard conditions‡ is the best available measure of the effective soluble zirconium-content of a melt. Saturation of melts with zirconium is always aimed at, since the special advantages of the zirconium alloys are in most cases dependent on a full zirconium-content for their realization.

Introduction of zirconium to magnesium is effected either by use of salt mixtures containing zirconium halides, *e.g.* zirmel master salt (based on ZrF_4), or "master alloys"§ made by reduction with excess magnesium of salt mixtures containing $ZrCl_4$. In making zirconium-alloy melts, care is required to avoid accidental contamination with aluminium-containing alloys, since one part of aluminium may precipitate up to twenty times its weight of zirconium.

Melt preparation is carried out in a similar

FIG. 4.—*Sand casting run with a large round sprue and screens, Alloy ZRE 1.*



* By repeated use on Mg/Al alloys, crucibles develop a "seasoned" surface which retards iron pick-up. The seasoning is destroyed by washing.

† Chemical methods are available which can effect an approximate separation between metallographically soluble and insoluble zirconium in as-cast samples. They are not intended for application to heat-treated or wrought alloys.

‡ Fortunately, the grain size of such bars is substantially independent of both metal and mould temperatures over reasonably wide ranges provided the soluble zirconium-content is not below about 0.5 per cent. In the binary alloy, the grain size is controlled primarily by the dissolved zirconium over virtually the whole range of zirconium content.

§ Such master alloys [7–8] are not fully metallic and contain entrapped chlorides, so that they must be carefully stored to prevent corrosion with consequent deterioration.

manner to that employed with the non-zirconium alloys, a heavy flux, rich in $BaCl_2$, being used however*. The zirconium-alloying material required to revivify the zirconium content of the melt is charged to the crucible along with the solid metal. When melting is complete, the metal surface is covered with flux and the temperature raised to about 800 deg. C. The melt is then puddled for a few minutes to complete reaction of the salt and liberate the zirconium into the body of the melt, after which a chill bar is cast and the fracture examined as a check on the efficiency of alloying. No rotary refining step is necessary since the puddling process, which is accompanied by application of flux to prevent burning, serves the same purpose. Degassing is also not required, since the achievement of a fine grain-size is itself an assurance that any hydrogen originally present has been reduced to an acceptable level.

Pouring

After a melt has been refined or puddled, and before the final flux cover is applied, it is desirable to clean the crucible lip and the neighbouring walls, and to cut away any encrusted flux adhering to the walls under the pouring lip at, or just below, the metal surface. Melts should be left for a few minutes after applying the final flux-cover before they are lifted for pouring.

When the crucible has been brought to the mould, any loose flux is removed from the pouring lip, crucible lugs, etc., the dusting of sulphur on to the metal surface is begun, the flux cover drawn gently back, and the melt cast. To minimize oxide formation, the crucible lip should be brought as close to the pouring basin as possible, thereby reducing the vertical height through which the metal must fall, and the metal itself should be poured as slowly as may be practicable in order to reduce turbulence.

With poor cleaning and pouring, it is possible in certain circumstances for several types of flux inclusion to arise in castings.† These are distinguishable microscopically, so that if any flux inclusions are ever encountered it is usually possible to say say how they have arisen.

(To be continued)

* See, for example, British Patent No. 652,234, Flux (f).

† The principal causes[5, 15] are: (*a*) insufficient care in cleaning the metal surface, accentuated by unabsorbed protective flux on the metal surface, a flux cover which is either too fluid or has been allowed to become dry and powdery through long standing (such covers should be replaced with fresh flux), or flux dust from the crucible rim, lugs, etc.); (*b*) sucking of an external chloride film into outercopping microporosity. (This requires the conjunction of bad feeding or the presence of gas with either poor cleaning of the metal surface or chloride contamination of the moulding sand.); (*c*) pouring much too fast; (*d*) leaving insufficient metal behind in the crucible after pouring; (*e*) use of unsuitable fluxes and alloying salts with zirconium alloys; and (*c*) and (*d*) can arise in zirconium alloys because the settled zirconium-rich particles make the bottom of the melt viscous and therefore capable of entrapping flux, which can be subsequently disturbed if pouring is excessively rapid.

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Publications Received

Management Views, March/April, 1957. Published by Remington Rand, Limited, 1/19, New Oxford Street, London, W.C.1.

The main portion of this publication carries the story of Holman Brothers, Limited, of Camborne, Cornwall. The article traces the firm's early beginnings in 1801 up to the present day, and incorporates Remington Rand's contribution to this organization.

Plastics Review. Issued by Bakelite, Limited, 12, Hobart Place, London, S.W.1.

In this booklet are illustrated some of the many uses of plastics and the reasons for their success are briefly discussed. From these, founders may be able to draw parallels when competition between plastics and castings is mooted. In the article on plastics in transport, the use of plastics by automobile manufacturers is described, and there is a picture of a motor cylinder manufactured from shell-moulds and cores made from sand bonded with Bakelite phenolic resins.

British Transport, 1956. Published by the British Transport Commission, 222, Marylebone Road, London, N.W.1. Price 1s.

The only thing that is missing from this "directors'" report is a vote of thanks to the staff. Otherwise, it takes the form of the chairman's speech to the shareholders in modern form—that is well illustrated with graphs for the statistical matter and photographs for the newer developments. It runs to 25 pages and in the traditional style finishes with the accounts. The information is interestingly presented, leaving but few questions for the "shareholders" to pose. The price charged is reasonable as the report does give an excellent overall picture of the state of British Transport.

Savings and Investment. Issued by the United Steel Companies, Limited, 17, Westbourne Road, Sheffield 10.

This pamphlet fills a real need, for, whilst the average working man is quite familiar with the not inconsiderable intricacies of betting on racehorses, he is lamentably ignorant of industrial share acquisition and disposal. Paradoxically, the poorer one is, the better is the return, as income tax becomes increasingly onerous with added income. This fact is used in the pamphlet to point out that rich people have so little left after taxation that no serious industrial investment can be made. This is no share-pushing booklet, since it clearly states that the issuing company is not advising employees to do anything and moreover, it stresses the advantage to be gained by spreading the risk and shows how it can be done. Foundry owners should try to obtain a copy of the pamphlet as it will enable them to enlighten their staff when questioned.

Founding in the "Emerald Isle"

A correspondent visiting foundries in Eire and Northern Ireland has submitted the following report on the state of trade, training, and future prospects:

Eire

The present trade depression and unemployment in the Irish Republic is developing along the same lines as in Britain in the 'thirties and amongst the industries "feeling the pinch" are iron and non-ferrous founding. For example, much of the normal production of the small Bell Foundry Limited, Dublin, is concerned with the moulding and the fabrication of gutters and piping, etc., for use in connection with housing construction. With some 9,000 building employees idle in the Dublin area alone, it can be gathered that there has been a serious falling off in the demands for all classes of materials used in connection with building construction. There is still, however, a certain demand for the type of work which gives the foundry its name—that of bell founding—orders for this work remaining steady.

An official of the Wexford Engineering Company, Limited, Wexford, informed the writer that while their foundrywork was concerned mainly with agricultural machinery, there was a fairly steady demand for castings used in connection with the engineering side of their business. As to labour, it was said that men could be obtained without any trouble. If the firm put an advertisement in the local paper for a vacancy, the next day would see a queue of some 50 to 100 yards long of men looking for a job.

Belfast:

The present year has seen a considerable improvement both in the number of contracts on hand among works in the Belfast area and in the volume of employment in the engineering industries, including the foundry trades.

In St. Anne's Ironworks, Musgrave & Company, Limited, Belfast, employment is steady with overtime being worked. Present contracts include cast-iron flooring for the new undertaking of British Thomson-Houston, Limited, at Larne, N. Ireland, sheet-metal fans for the atomic power-station at Dounreay, Caithness. Much of the work being done is sub-contract work, including cast-iron pipes and castings for electrical motors, power fans and tea-processing machinery. At present there are no castings contracts on hand for machine-tools but another item on hand is bed frames for fans for heating and ventilating machinery. The labour position here is satisfactory, most of the employees remaining their lifetimes with the firm, though trouble is experienced securing suitable apprentices. Boys start to "serve their time," but it appears that when they see the rather dirty nature of the work, they are inclined to leave. However, a day-release scheme is being operated. Current work on hand includes a number of sub-contracts for local power-stations and for tea machinery for India and the Union of South Africa.

In the much larger "Sirocco" Ironworks, of Davidson Limited, Newtonards Road, Belfast, it was found there was ample work on hand, with full employment. The foundry is working a five-day week, but the finishing time on most days is 8 p.m. Important contracts for ventilating machinery for a number of atomic power-stations are in hand, as are also contracts for the National Coal Board for pit-ventilating machinery. Tea machinery is also being manufactured for export to many countries; this firm has been manufacturing this type of machinery for many years now. However, owing to the present rather confused trading position in India, where the Indian Government has been restricting licences for the import of machinery, the position for machinery exports from the UK is not so satisfactory as it was. Nevertheless, considerable business is being done in the export of machinery in connection with the establishment of a new tea-growing industry in Kenya. The Belfast firm not only manufacture the machinery but train men to supervise erection and operation of this type of machinery in all the countries the machines are sent to.

Transport Difficulties

The main "headache" at present for this firm, in common with other Northern Ireland firms, is that of transport. The ordinary service by railway and steamer is too slow, making it difficult to dispatch orders on time. Such service as the Anglo-Continental ferry can deliver goods to Birmingham from Belfast within 48 hours, as compared with a week by the ordinary railway service. Unfortunately this new service is expensive. Such transport and other problems peculiar to Northern Ireland make it necessary for industry, if it is to be competitive with English and Scottish firms, to be run in a most economical fashion. In Davidson's costs are kept down by using skilled staff to cut the cost of production by introducing cheaper methods.

Much of the contract work in this Belfast firm is to satisfy the custom-built type of requirements. In the course of a tour of the foundry, the work's foreman informed the writer that in this connection the firm had a stock of some 52,000 patterns which were worked from time to time. Fifteen to twenty years ago, it appears that most of the moulders employed (some 60 per cent.), served their time in other areas, and in the early days of the foundry many of their staff of moulders had come from foundries in central Scotland. To-day, however, most of the moulders are natives of Belfast.

Davidson's melt up to 100 tons per week, 6½ tons per hour, the cupola normally employed being 42-in. dia. Mainly green-sand moulding methods are used, but at present they are introducing the CO_2 Process.

Training

The firm runs a very comprehensive system of training for their apprentices. Boys of school-leaving age are asked to apply and are expected to attend day-release classes and other instruction arranged for them. They serve first one year at the bench and at 16-years-old start to serve their normal apprenticeship. In actual practice, however, out of every ten apprentices the firm considers that it is fortunate if it obtains four fully-fledged moulders. The firm also has "premium" apprentices; these are specially picked by the directors and serve a five-years' apprenticeship, working in each department and finishing in the drawing office. These apprentices are destined to become executives and are expected to have reached matriculation standard before entering the firm. At present, there are also eight tea-machinery engineers undergoing training. These will eventually be responsible for the erection and supervision of tea machinery in the various countries served by the firm. It is, of course, well realized that, as countries like India become more fully industralized, they will probably manufacture much of their own machinery requirements, for example, tea machinery. This however is in the future, for the present, work on hand on existing contracts, including developments in the nuclear-energy field, is likely to keep the firm fully occupied for a considerable time.

H

Stanton Ironworks Orders GEC Turbo-alternator

A further order from the Stanton Ironworks Company, Limited, in connection with a comprehensive scheme for ore preparation ahead of the blast furnaces has been received by the Fraser & Chalmers Engineering Works of the General Electric Company, Limited. The order is for a 6,000 kw high-pressure turbo-alternator, operating with steam at 425 p.s.i.g., 750 deg. F., and generating at 11 kv. The set is being installed to supply the power requirements of the new plant.

The ore-preparation scheme, which is being constructed at the Stanton works, includes a plant for blending the incoming ore after it has been crushed, in order to ensure an even grade of the desired iron content prior to further treatment in the materials feed line to the blast furnaces. The blending plant, placed on order with the Fraser & Chalmers Engineering Works last year, includes a wing stacker, two reclaiming machines, and two transfer cars together with the associated conveyors for stacking and reclaiming the ore.

VICKERS-ARMSTRONGS (AIRCRAFT), LIMITED—Mr. H. H. Gardner, Mr. A. W. E. Houghton, Mr. B. Stephenson, and Mr. S. P. Woodley have been appointed to the board.

UK Firm Gets Danish Order for Reactor

A contract for the design, engineering procurement, and erection supervision of a materials testing reactor for the Danish Atomic Energy Commission, has been awarded to Head Wrightson Processes, Limited, a subsidiary of Head, Wrightson & Company, Limited, engineers, iron and steel founders, of Thornaby-on-Tees (Yorks).

The company is at present engaged on the erection of three similar research reactors for the UK Atomic Energy Authority and one for the Australian Atomic Energy Commission.

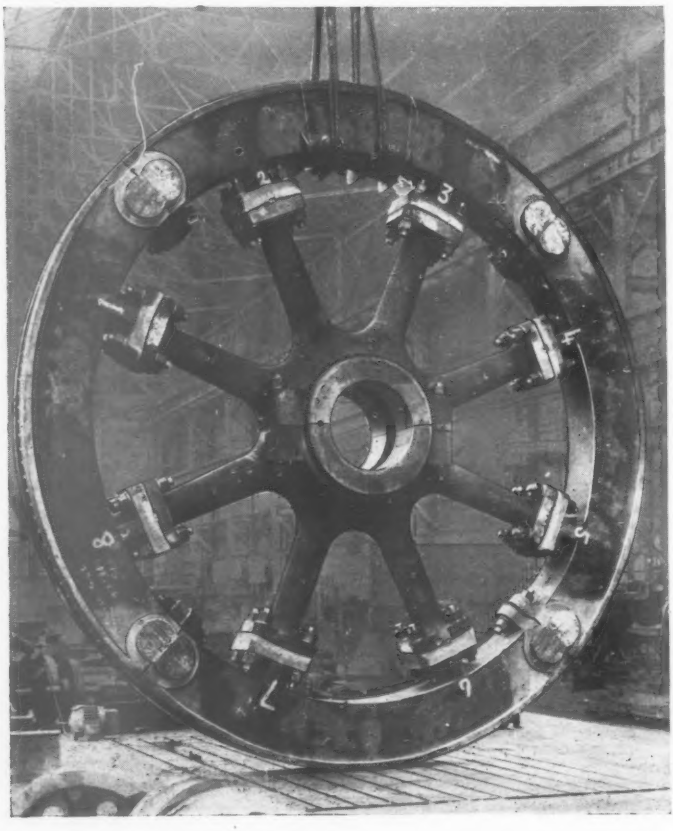
Import Restriction

Following discussions in Washington between the United States and the United Kingdom governments on the scrap situation in the US and the requirements of the British steel industry, the UK steel industry will limit its imports of heavy melting scrap from the United States during 1957 to or below certain levels proposed.

Announcing this recently, the British Iron and Steel Federation stated that this would not affect steel production in the United Kingdom. It is understood that the figures for the new limits will not be published. Imports of scrap from the US have been falling of late.

Canadian Steel Production

Capacity production is being maintained by the Canadian steel and pig-iron industry. In the first quarter of this year production was considerably higher than in the same period of 1956. Steel production for the first quarter increased to 1,366,819 (1,275,063) tons. Pig-iron production in the same period rose to 932,347 (846,183) tons.



Assembled pilger-mill wheel, produced by F. H. Lloyd & Company, Limited, of Wednesbury, for Wellman Smith Owen Company, Limited. The assembly, and the jockey carriage will be installed in the plant of Stewarts and Lloyds, Limited, at Clydesdale, Scotland. It is an example of composite construction, currently being developed, to secure ease of founding and hence maximum soundness and strength of components.*

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* A photograph of the jockey carriage was published in the FOUNDRY TRADE JOURNAL, April 18.

Scandinavian Foundry Review*

As a prelude to the International Foundry Congress (August 19 to 25), at which the Scandinavian countries—Norway, Sweden, Denmark and Finland—are the hosts, the Editor has conducted a special mission of investigation into foundries and foundry practice carried on in these countries. What follow are brief accounts of the layout, buildings and plant of a number of typical installations, enriched in each case with comparative comment drawn from the writer's unique experience of a great many foundries at home and abroad. In the section printed this week, the ASEA† group of foundries and the Domnarfvet foundry, in Sweden, are reviewed.

ASEA

The outstanding feature of the ASEA group of foundries, which caters for the largest makers of electric plant in Sweden, is the extensive use of mechanical-handling plant; especially fork-lift trucks, the fettling and coreshops being particularly well served in this respect. The basis sand used in these foundries is of glacial origin, and is subjected to meticulous care in preparation; these plants are push-button operated by a man seated at a control station (Fig. 2). Some of the moulding machines have been made automatic, and future suppliers will be furnished with the tested improvements for incorporating in their products. The attention which has been paid in providing good working conditions would certainly satisfy the most pernickety factory inspector. Various items of plant and phases of operation are shown in the accompanying illustrations, Figs. 1 to 9. The writer wishes to record his thanks to Mr. Granstrom for the notes provided, on which the following description is based.

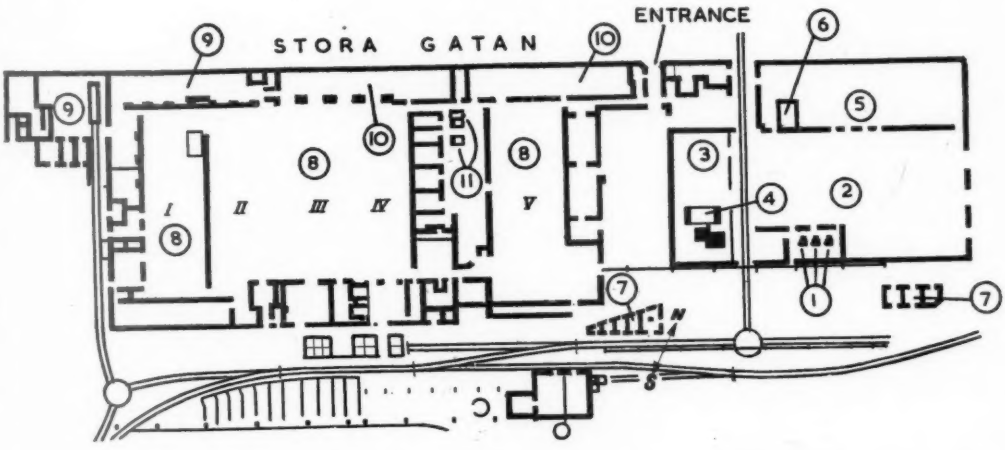


FIG. 1.—*Plan of the ASEA foundries at Västerås, showing the location of the principal sections of the grey-iron section.*

(1) Three 7-*tonnes* per hour cupolas; (2) moulding shop; (3) fettling shop; (4) Hydroblast plant; (5) coreshop; (6) offices; (7) raw-material storage bins; (8) mechanized moulding shop, with five sections, I, II, III, IV and V; (9) fettling shops; (10) coreshops and (11) core-oven.

* A further eight foundries will be described under this heading in future issues of the JOURNAL.

† The photograph, heading this article, is a night view of the exterior of the ASEA foundries at Västeras, Sweden, and shows the care which appears to have been given to the exterior design of the modern plants in this country.

Scandinavian Foundry Review

History

ASEA's first non-ferrous foundry at Västerås came into being during 1899-1900, occupying the same site as the present laboratory block. It was demolished during 1930, when a section in the machine-moulding foundry was arranged for non-ferrous castings. The company's first foundry of any real importance was built and brought into use during 1897-98, being established for the production of grey-iron castings, and was situated to the south of the present machine-moulding foundry. Considering conditions appertaining at that time, this foundry was both large and modern, having a floor area of about 18,300 sq. ft. During 1912-13, the foundry premises were enlarged, a department for machine-moulding, offices and bath rooms being added. This foundry was, however, closed down in 1943. The first high-frequency furnace with a charge capacity of 10 cwts. for non-ferrous castings (copper alloys) was installed in 1941.

The principal layout of the ASEA foundries of to-day are shown in Fig. 1, the iron foundries being situated in two buildings along the Stora gatan. The block of buildings for machine-moulded castings was built in stages, over a period of years, and was first completed at the end of 1952. The latest addition comprises premises for the fettling shop, patternshop, etc. One noteworthy aspect of these buildings is that both alterations and additions took place during full foundry operation. The first high-frequency furnace for melting iron was put into commission in 1942, whilst two 8-ton units now

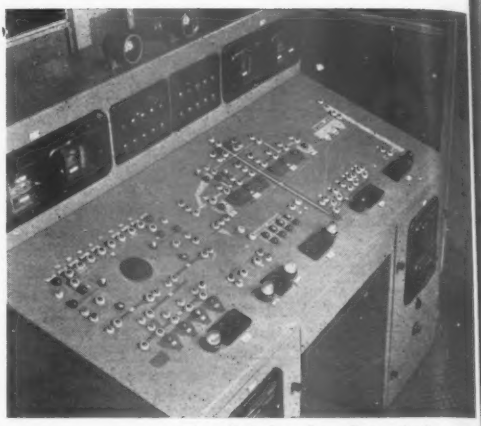


FIG. 2 (*above*).—*One of the two control panels for the sand-preparation plant, which is fully automatic in operation (ASEA iron foundry).*

FIG. 3.—*Moulding pit in the hand moulding department of the ASEA grey-iron foundries is employed for the production of large castings up to 40 tons in weight*

FIG. 4.—*General view of the hand-moulding shop, a mould is being assembled with the aid of one of the many overhead-travelling cranes that are a feature of the ASEA foundry departments.*

FIG. 5.—*Stages in the production of castings, produced in a moulding pit in the hand-moulding section of the ASEA iron foundries: (a) assembly of the first sections of the coring for a marine engine casting; (b) final assembly of the cores, and (c) one half of a casting for a hydro-electric generator.*

in use, were built in 1946. The floor area of the iron and non-ferrous foundries amounts to more than 535,000 sq. ft., some 500 people being employed.

Hand-moulding Foundry

Melting Plant

The melting plant consists of three cupola furnaces, each with a capacity of about 7 *tonnes* per hour, and a melting-zone diameter of 43-in. Charge weight is in the order of 15½ cwt. of iron, with an additional 12 per cent. coke, by weight. The furnaces are all provided with tilting accessories, thus enabling continuous tapping and deslagging to be practised.

FIG. 6.—*Moulder finishing the bottom part of a mould for the frame casting of a winch for use in cargo ships; the completed top-section of the mould can also be seen (ASEA hand-moulding foundry).*

Moulding Departments

There are three moulding shops, the northern one being served by two overhead-travelling cranes and used for the production of medium-sized castings; the central shop is intended for large, whilst

FIG. 7.—*Automatic weighing of boxless moulds; after pouring, the trolleys are returned beneath the platform to the moulding machines (ASEA grey-iron foundries).*

the southern is used for small castings. A mould drying oven, fired with coal gas, which is used for drying large moulds, is situated beside the melting furnaces. Vibratory knockouts are provided for castings up to 40 tons in the central shop and up to 10 tons in the northern shop, where there is a Motive Junior Sandslinger with an output of 10.6 cub. ft. of sand per minute.

Sand-preparation Plant

Sand is prepared by two Speedmullor 60's for mould sand, and one Speedmullor 40 with two Fordath mixers for core sand. The sand preparation plant for mould sand is fully automatic, control being effected, remotely, by a push-button panel (Fig. 2), and is equipped with moisture control. A dust-extraction plant, connected to electrostatic precipitators, is also provided.

Coremaking Plant

The coremaking plant, situated in two shops, is for the manufacture of small cores, partly with the aid of machines of ASEA design. Cold-setting binder, of Swiss origin, or cement sand is used for the majority of the cores, which are dried together with a certain amount of smaller moulds, in three drying ovens.

Fettling Shop

The fettling shop is located in an extension to the three moulding shops in the western part of the foundry. It is separated from these by a special sound-insulating partition, the upper part of which is provided with sluice gates, which are operated from overhead cranes, and allow the castings to be conveyed from the moulding to fettling shop, without any rehandling. Coarse dressing is carried out in a Hydroblast cleaning plant. Dressing is effected by a jet of water and sand grains at a pressure of 1,780 lb. per sq. in., at a rate of 55 gal. per min. The plant is operated either with two manual sprays inside the blasting chamber, or with a fixed jet arrangement. Fettling is carried out with the aid of pneumatic chisels and hand-operated grinders.

Ventilation

The ventilating system is very effective, the air being changed six times per hour. In the main moulding shop, the fumes etc., are extracted with the aid of a drum ventilator, in the apex of the roof; the sides of this drum are provided with suction inlets. The air from drum ventilators and side bays is extracted by impellers—the total volume of extracted air amounts to 345,300 cub. yd. per hr. Fresh air enters into the different departments through radiators, fans and unit heaters. The total capacity of the fresh-air fans is 285,150 cub. yd. per hr. A modern washing, bathing and changing room, accommodating 150 men, is provided in the basement.

Machine-moulding Foundry

Melting Plant

Two 8-ton ASEA high-frequency furnaces are located here. The molten iron, which is held in a mixer with a capacity of 17 tons, is transferred to and from the furnaces by a 75-ton overhead crane. The temperature of the iron on leaving the furnaces is about 1,600 deg. C., drops to 1,430 deg. C. when poured from the mixers. Large skips, which are filled with the charge material by a lifting magnet, are used for charging the furnaces; the skips are driven, on a trolley, up to the furnace where they are discharged.

Moulding Departments

Small castings are made in boxless moulds, on 17 Webac pneumatic-moulding machines. The moulder removes the moulds from the machine and places them on a four mould trolley, which runs on rails to the knockout section.

These trolleys return to the moulder beneath the platform. The moulds are then automatically weighted (Fig. 9) pneumatically, and cast up before reaching the knockouts. The cast up moulds are tipped on to a mesh conveyor belt just below at floor level which moves them towards a Vibrosikt vibrating screen, where castings and sand are separated. The sand is returned to the sand preparation plant, while the castings are delivered to the fettling shop.

Medium-sized castings are moulded in another mechanized section, and transported accordingly on a parallel roller-pathway system, at the end of which are provided pneumatic knocking-out machines. Moulding is effected by 20 pneumatic moulding machines, roller pathways linking them and the

shake-out gratings. Large castings are provided in another moulding section, which is also mechanized following a horseshoe pattern of roller conveyors. Equipment comprises two large pneumatic jolt/squeeze and turn-over moulding machines, a turntable measuring 87 to 63 in., and a 59 in. lift, and 14 medium-sized pneumatic-moulding machines. After pouring, moulds pass through tunnels provided with exhaust fans and fresh-air intakes in order effectively to remove the gases formed.

Sand-preparation Plant

The sand plant comprises two exactly similar units, each with an output of 52 cub. yds. of finished sand per hour, one intended for coarse the other for fine sand. The plant, which was designed and constructed by the Swiss firm George Fischer, Schaffhausen, is operated from a special control room. Coal dust and binder are added automatically, while the sand is weighed and distributed by means of push-button operation from the control desk.

Coreshop

Core sand is prepared in two oil-sand mixers and dried in a rotating drum, with a capacity of four tons per hour. This dryer is fired with coal gas and controlled by a thermostat; after leaving the dryer the core sand is cooled in a gravity cooler.

The coreshop is divided into two sections, one for small and one for large cores, the smaller cores are made on core benches, equipped with vibrating tables and core-removing devices, with magnetic chucks; bench-type coreblowers, and conventional 1-gall. capacity coreblowers, all of which are placed adjacent to a steel band conveyor. This delivers the cores to two vertical drying ovens, made by Svenska Fläktfabriken, which can be heated by electricity or coal gas; the circulating time being of the order of two to four hours. Larger cores are produced in a special department, mainly with a 7-gall. coreblower and are dried in stoves, heated with electricity or coal gas.

Fettling Shop

The fettling shop has been built in two floors. On the bottom floor, there are two Wheelabrator shot-blasting machines of the drum-type, and a continuous Gutmann shot-blasting machine, with a chain conveyor. Fine dressing and painting is effected on the upper floor; which is also equipped with a painting unit, with a chain conveyor, for continuous and automatic dipping of the castings, which are then dried in a coal-gas-fired oven.

Ventilation

Sections where casting takes place are provided with an amply dimensioned ventilating equipment; air is changed from 5 to 8 times per hour. The total amount of air delivered to the machine-moulding foundry

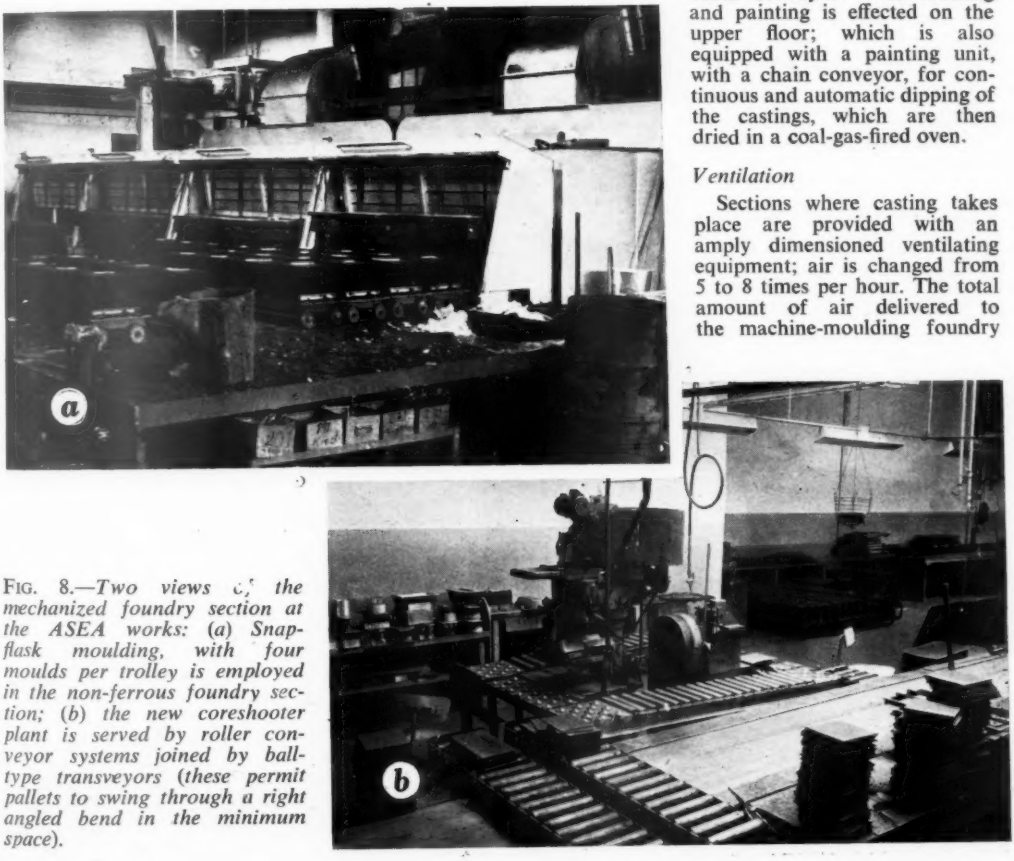


FIG. 8.—*Two views of the mechanized foundry section at the ASEA works: (a) Snap-flask moulding, with four moulds per trolley is employed in the non-ferrous foundry section; (b) the new coreshooter plant is served by roller conveyor systems joined by ball-type transveyors (these permit pallets to swing through a right angled bend in the minimum space).*

Scandinavian Foundry Review

is approximately 784,800 cub. yd. per hour. Electrostatic precipitator units are connected up to the mechanical-centrifugal separators, so that even dust particles with a diameter of one micron are effectively separated. These precipitator units have a total capacity of about 222,400 cub. yd. per hour, and are connected up to the grinders, shot-blasting machines, knock-out stations, sand preparation plant, etc.

The spacious amenity block comprises a canteen for 120 men and two underground washrooms, each for 150 employees. Another washroom for a further 90 men is connected with the new fettling shop, which is also equipped with a first-aid room.

Patternshops, repair shops and stores are provided for the joint needs of the different foundry departments. The patternshops staffed by 85 men, produce metal patterns and pattern plates; patterns for hand-made moulds, large machine-made moulds and for small orders are made of wood, while the other machine-made patterns are fabricated from non-ferrous metal. The repair workshops, employing about 50 men, are also well equipped with all necessary machines.

Non-ferrous Foundry, and High-duty Iron Foundry

The moulding section of the non-ferrous foundry, which was completed at the end of 1948, is tiled in white ceramic, an unusual feature for a foundry, but they facilitate cleaning and make the locality both light and pleasant for operations. The sand preparation plant and moulding in these foundries, are also fully mechanized.

Melting Plant

Melting is effected in one 22-cwt. (used for high-duty cast iron) and two 11-cwt. high frequency furnaces, and in three 4-cwt. resistance furnaces, the latter being used for light-alloy metals. High-frequency current is generated by two converters, each rated as 300 kw. A noteworthy point is that the entire furnace equipment has been manufactured by ASEA.

Moulding Departments

One moulding department is used for boxless moulding, which has been mechanized, and also some hand-moulding, whilst machine-moulding of large items and hand-moulding take place in the other department. Amply dimensioned ventilating equipment is also provided, the air being changed 11 times per hour.

Sand-preparation Plant

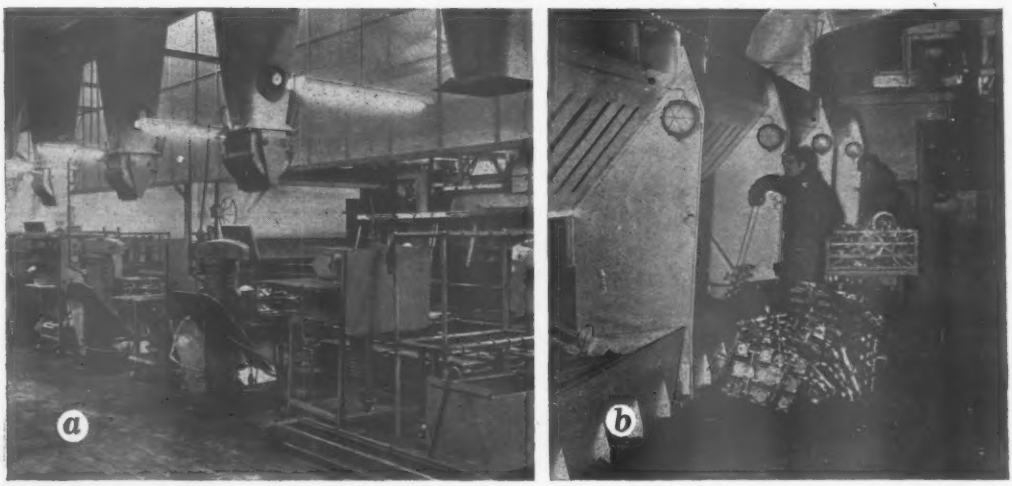
The sand plant comprises two similar units, each with an output of 565 cub. ft. per hour; sand is prepared in roughly the same way as that used in the machine-moulding foundry. The prepared sand is removed on a conveyor belt, under the roof, while the spill and shake-out sand is returned to the preparation plant, by a conveyor belt underneath the floor.

Other Sections

The core-making plant is equipped with a roll-over machine, a bench core blower and a 1-gall. capacity blowing-machine. Three electric drying ovens, each rated at 50 kw., made by Svenska Fläktfabriken, are provided for core drying.

The fettling shop is equipped with a Gutmann shot-blasting machine, various grinders and an

FIG. 9.—*Two views of the non-ferrous foundry of ASEA: (a) The mechanized moulding department, showing three of the 17 Webac pneumatic-moulding machines, with overhead sand-delivery hoppers and (b) ventilated knock-out in the brass foundry; castings are loaded into stillages and transported by means of fork-lift trucks.*



annealing furnace for the castings. Both the fettling shop and the sand preparation plant are provided with their own central dust-extraction plant, connected to electrostatic preciptators. Efficient ventilating and heating equipment is also provided for these premises, as well as modern personnel rooms.

A special test room is situated in the sand preparation plant for the routine testing and control of the sand and other raw materials. All the standard metallurgical tests on the castings and metals used in the foundries are carried out in the ASEA metallurgical laboratory, which forms part of the general laboratory block of buildings at Västerås.

Swedish Steel Foundry

The steel foundry at Domnarfvet is a department of Sweden's largest steelworks. This is a part of the Storakopparsbergs Group which must rank amongst the oldest companies in the world. Originally based on the great copper mountain at Falun, there is a document in existence which records the transfer of an eighth share in the copper mountain to Bishop Peter Elofsson in 1288. The Domnarfvet works were built between 1872 and 1878 to centralizé Storakopparsbergs iron manufacturing activities. The present steel foundry (Fig. 10) was built in 1950. It was planned and built to reduce dust and fume to the minimum, as there existed under the former working conditions an unwholesome history of silicosis amongst the employees, largely due to the need to exclude the cold from the shops.

About 130 men, including some 15 skilled workers, are employed in this foundry. The weight range of castings produced is from a few pounds to 50 tons. The area under cover is about 91,500 sq. ft.; the general layout of the shops is shown in Fig. 11, but this does not include a roofed-over, but open-sided fettling shop. It will be noticed that there is no large-scale melting plant included, as for large castings the metal comes from the steelworks, where very large electric-furnace plant is available; the latter is being extended to include an 85-ton capacity furnace. Though the ladles of liquid metal have to cross a river, it takes only seven minutes for their journey to the foundry.

For melting steel for the smaller castings, there is a 4-ton Rennerfeld furnace, served by 2,000 kva. transformers. It is basic lined and takes about five hours for a melt, using a two-slag process. The current consumption is of the order of 850 units per ton. This 35-year-old furnace has given and is giving very good service. It is almost completely enclosed in a hood and no fume escapes into the shop.

Moulding

Both green- and dry-sand moulding is practised. In recent times, extensive experiments have been made in olivine sand and the results are so promising that in September this year, on the occasion of the annual holiday, the whole of the foundry is to be turned over to the use of olivine-sand, the additions being bentonite and a cereal binder. (As this is a steel foundry, no coal-dust is added as would be the case when using olivine sand in an iron foundry.) Olivine sand is more expensive than silica but the management insist that it is better to pay money for raw material than for workmen's compensation. It is interesting to record that Brown-Boveri electric stoves are used in this foundry for mould drying.

FIG. 10.—*Exterior of the steel foundry at Domnarfvet in Sweden; it forms part of the country's largest steelworks.*

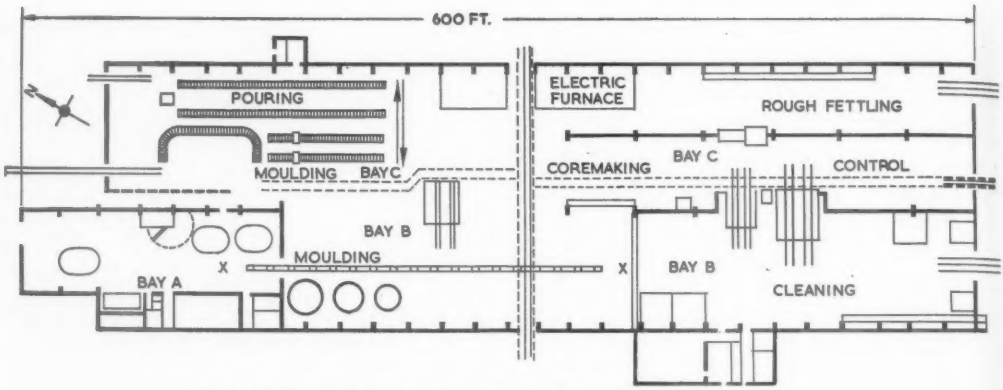


FIG. 11.—*General layout plan of the Domnarfvet steel foundry.*

Division of Work

The foundry, which runs north and south, has four bays, A, B, C and D (see Fig. 11). The largest castings are made in bay A, which is spanned by a 100-ton electric overhead travelling crane, the hook and chains of which are protected by the combined lifting and canopy device shown in Fig. 12. The medium-size castings are produced on the floor of bay B as far as the wall, denoted by (X) in Fig. 11, which reaches about two-thirds of the height to the roof, and so can be spanned by the overhead cranes, the largest of which in this bay has a lifting capacity of 50 tons. South of the wall (X), the shaking out of the heavy and medium-size castings takes place in an enclosed, well-ventilated knock-out chamber. This 60-ton capacity shake-out is divided into four sections, the whole of which can be used together or quite separately. The castings are then taken to a Pangborn water-blast room, where cleaning can be effected from internal guns or from outside. External operation is made possible as the castings are placed on a table which can be rotated. The castings made in bays A and B are all from dry-sand moulds.

At the north end of bay C, the production of green-sand machine-moulded castings takes place (Fig. 13). These castings are transported to bay D on roller conveyors. Here, considerable use is made of Sterling moulding boxes. Between bays B and C, there are two large oil-fired annealing ovens (with gas-firing as a stand-by). The bogies serving these ovens are handled in and out by the overhead cranes, using snatch blocks.

The coremaking department is situated in the middle of bay C. The cores are dried in electrically-heated air-recirculating ovens equipped with well-insulated doors.

In bay A, there are three pits for the moulding of the largest castings, one of them being shown in Fig. 14. The walls of each pit have six exhaust openings divided horizontally into three parts. By selecting the appropriate extraction louvre, it is possible to control exhaust at the actual working level.

Ventilation

Whilst passing mention has been made of dust and fume extraction, it should be stressed that, in addition to removal of dust and fumes at various points in the production sequence, there is good general ventilation of the foundry. The cubic area of the foundry is more than 115,000 cub. yards, and the capacity of the exhaust fans is in excess of 225,000 sq. yds.

In winter the atmosphere is changed twice, and in summer three times, per hour. On a cold winter's day—the foundry is in central Sweden—the system requires 1,750,000 calories per hour to heat the replacement air coming from outside. This means that 2½ tons of coal are consumed every day.

FIG. 12.—*Teeming in progress at Domnarfvet; note the ladle carrying attachment and canopy.*

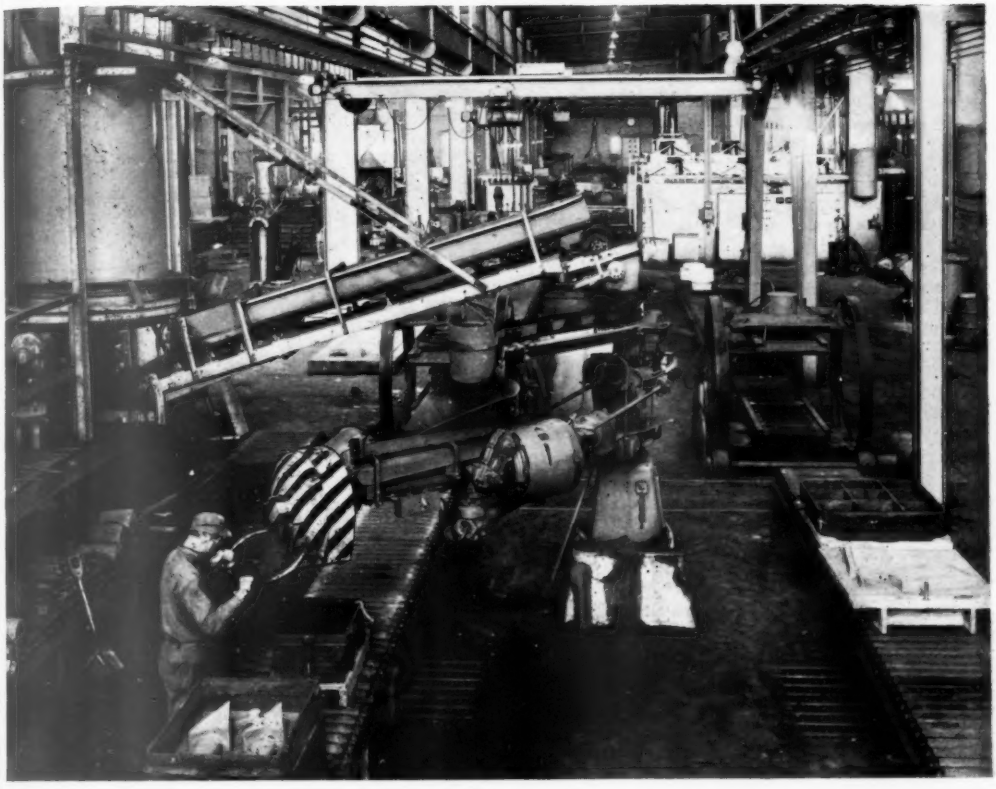


FIG. 13.—*Smaller types of castings produced at the Domnarfvet foundry are moulded by Sandslinger while carried on roller track. Note the zebra stripes on the impeller head—a course generally adopted in Sweden to indicate danger points.*

Amenities

The bathing, washing and changing facilities available to the foundrymen are admirable, but it has been deemed wise not to instal clothes lockers, preference being given to the hanging of working clothes in a room having good air-circulation. To provide recreation for the long winter evenings, indoor tennis and a form of bowls are available. A comfortable club is provided for pensioners, and the first-aid and medical services,

FIG. 14.—*One of the large moulding pits, from which dust-extraction is arranged. Assembly of a large mould is in progress* (*Domnarfvet*).

Scandinavian Foundry Review

which cater for the whole works, are of a very high order.

The writer did not inspect the firm's iron foundry which, each year, turns out about 18,000 tons of ingot moulds, bottom-plates, slag bogies and other steelworks plant. There is also a small non-ferrous foundry making some 125 tons of general castings a year mainly for plant maintenance.

A considerable difficulty has been experienced in getting apprentices, owing to a silicosis complex amongst employees, but this should certainly disappear, as the ventilation system has proved very effective in the new steel foundry and, moreover, in a few months there will be only olivine and no silica sand used.

The writer wishes to thank Mr. A. Huldt of the Domnarfvet works for the cordial reception accorded to him and for the considerable help given in the preparation of this article.

(*Review to be continued*)

Law Cases

Claim for Loss of Eye Dismissed

Claim for damages for the loss of a right eye was dismissed at Sheffield Assizes by Mr. Justice Ashworth. The plaintiff was Mr. William Henry Rider (49) and he sued the Hepworth Iron Company (Engineering), Limited, Hazelhead, Sheffield.

Mr. R. P. Smith, for Mr. Rider, said the plaintiff was struck in the eye by the driving pin or stud which shot out from the plate on the grinding machine on which he was working in 1955. He had noticed eight or nine months before the accident that the hole into which the peg was screwed was worn. Mr. Rider claimed the machine was old and that he had mentioned the defect to his employers.

Dismissing the claim, Mr. Justice Ashworth said he was satisfied that Mr. Rider said nothing before the accident which called for action by the firm. "I think he probably made some sort of criticism of the machine, but the complaint was not one directed to the worn threads in the hole. It was almost certainly a comprehensive collection of criticisms of this machine.

"I am satisfied there was nothing brought to the defendant's notice by him which would impose liability on the company," the judge said.

£200 Claim Rejected

At the West Bromwich County Court last week, Judge R. H. Norris said he could find no case where it was the duty of an employer to inspect workmen and to insist on them wearing protective clothing or leave the job. He rejected a claim for £200 damages from a moulder who had his foot burned, when not wearing the protective spats which had been issued to him. (Full details of the claim were reported in the JOURNAL, July 4 issue, p. 19).

large boxes, and burned Bunsen-burner fashion is also an established foundry way of drying in a clean and uniform manner. A rotary-type of mixer, plus a few of these split-brick burners spaced out inside a large mould, would seem to offer an acceptable and efficient alternative to some of the present methods where mould drying is necessary, and mould handling is not possible.

Industrial Utilization of Gas

North Eastern Gas Board's Conference in Leeds

A large party interested in the latest developments of town's gas for industrial purposes, were invited by the Gas Council and the North Eastern Gas Board to a conference and works visit to industrial users of gas at the end of last month. At the Yorkshire Copper Works, Limited, for example, which constitutes the largest single consumer of gas in the North Eastern Gas Board's area, the continual progress and developments in "semi-automatic" processes used in the manufacture of the well-known "Yorkshire" copper tubes and fittings has been greatly facilitated by the closely controlled uniformity of heat volume, in varying degrees, according to the number of gas burners and the length of the furnaces. Here, the cleanliness and convenience of town's gas was said to be far in excess of any other source of heating for their requirements. The consumption figures were now of the order of 437-million cub. ft. per annum.

Clayton, Son & Company, Limited, engineers, also of Leeds, had open for inspection by the visitors several applications of high-intensity, gas-heating burners, which permit the use of town's gas for welding and other purposes in the manufacture and manipulation of their large-diameter steel pipes. The time saved in heating and welding with the adoption of the latest gas-burning units designed by the N.E. Gas Board's Research Centre, has been a notable feature of the changeover to town's gas from water gas, to suit the special heating requirements.

New Burner

Of special interest to foundrymen, was the demonstration at the Gas Board's works at Bridge Street, Leeds, of an entirely new type of jet burner for town's gas. This also has been developed at the Research Centre at Bradford. It works with 5-lb. per sq. in. gas pressure and compressed air at the same pressure, piped into a rotary-type mixer, and from there delivered in one pipe to a cone-type of burner, which is placed inside a split, circular refractory brick "sandwich," adjusted to produce an intensely hot, adjustable flame of large diameter, giving a pyrometer reading of 1,750 deg. C.

This type of burner has been expressly developed for internally heating local sections, for example, the seats of valve bodies up to two tons in weight, where the inside parts to be metal sprayed can now be heated to "red" in 12 minutes, against the previous six hours with other methods. The differential in costs is most attractive, gas consumption through the special jet burner, being quoted as costing under three shillings. Refractory materials were said to present a major problem in this application at present, but these were under continual research and were improving with each phase. Another interesting development on view here, were "mock-up" furnace-bottoms, arranged with a "slit-brick" type of narrow slot to produce a flat flame, this appeared capable of application in various ways in the foundry with advantage.

Fan-blown gas has been used for cupola lighting, without firewood, for many years, with the obvious advantage that when turning the gas off once the bottom coke is freely burning, the small blower fan can be left running for a time to promote an incandescent bed, prior to charging the furnace.

Town's gas piped into pit moulds and those made in

(*Continued at foot of col. one*)

Company News

CRONITE FOUNDRY COMPANY, LIMITED—An interim dividend of 10 per cent. compares with a corresponding payment of 7½ per cent.

SUPER OIL SEALS & GASKETS, LIMITED—An interim dividend of 7½ per cent. compares with a corresponding payment last year of 10 per cent.

W. H. BAXTER, LIMITED, engineers and ironfounders, of Leeds—Net profit for the year to March 31, 1957 was £12,733 (£1,006); the dividend is 20 per cent. (12½ per cent.).

METAL BOX COMPANY OF SOUTH AFRICA, LIMITED—The company has announced its anticipated one-for-one rights offer of £1 ordinary shares at par to holders of the existing £1,050,000 ordinary capital.

JOHNSON, MATTHEY & COMPANY, LIMITED, smelters, refiners, and engineers, of London, E.C.1—A final dividend of 7 per cent. for the year ended March 31 makes a total of 10 (9) per cent. Group net profit was £945,498 (£1,032,747).

GUEST, KEEN & NETTLEFOLDS, LIMITED—The New Issues Committee of the Edinburgh Stock Exchange has granted a quotation of 6,941,337 ordinary £1 shares of the company (rights issue) on the issue of provisional allotment letters.

JOHN HARPER (MEEHANITE), LIMITED—A final dividend of 3d. makes 4¼d., tax free, per 1s. share on increased capital for the year to March 31, 1957, compared with 5d., tax free, on the old capital. Profit is £125,174 (£88,618), less tax of £63,704 (£47,444).

SWAN, HUNTER, & WIGHAM RICHARDSON, LIMITED—The interim dividend is raised from 3 per cent. to 5 per cent. on the £3,422,128 ordinary capital in respect of 1957. For the previous year the total payment was brought up to 14 per cent. with a final of 11 per cent.

BROWN & TAWSE, LIMITED, iron and steel merchants and engineers, of London, E.3—The company, which was made public in September, 1956, is paying 10 per cent. on its ordinary capital for the year to March 31, 1957. Net profit attributable to the company is £173,341 (£126,363).

JOHN THOMPSON, LIMITED—The recent issue of 1,048,227 5s. ordinary shares at 25s. each was heavily over-subscribed. Excess share applications total 519,618. Applications for excess shares up to and including six in number will be accepted in full. Applications for larger numbers will be subject to considerable scaling down.

WILLIAMSON MANUFACTURING COMPANY, LIMITED, scientific instrument makers, etc., of London, N.W.10—Following a sharp setback in profits, the company is reducing the dividend from 25 per cent. to 15⅝ per cent. by halving the final to 9⅜ per cent. for the year to March 31, 1957. Net profit, after tax, is £26,254 (£42,363).

CALEDON SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Dundee—The company is effectively raising its dividend by 3 per cent. for the year to March 31 last with a payment of 8 per cent. on capital doubled by a free scrip issue, against the equivalent rate of 5 per cent. in force for a number of years past. Net profit after tax is £91,187 (£91,469).

BIRFIELD, LIMITED—Applications up to and including £10,000 have been allotted in full in connection with issue of £1,500,000 6 per cent. unsecured loan stock. Larger applications were scaled down by approximately 20 per cent. except in cases where the application was out of proportion to holdings in the company. In such cases allotments were restricted to £10,000.

DORMAN, LONG & COMPANY, LIMITED—The company has decided to make a 1 per cent. increase on the interim dividend at 4 per cent. in respect of the year to September 30, 1957. The dividend is payable on August 15 to holders registered on July 15. For the previous year the final was 5 per cent., making 8 per cent. on the £15,000,000 ordinary capital.

UNITED STEEL COMPANIES, LIMITED—An extra-ordinary meeting has been called for July 17 to approve the one-for-two scrip issue to ordinary holders. It is also proposed to increase the capital to £50,000,000 by the creation of 20,000,000 additional £1 shares. The board has, however, no present intention of issuing more than the 10,000,000 shares involved in the scrip issue.

ANTI-ATTRITION METAL COMPANY, LIMITED—An offer to acquire the company's 4,000,000 2s. shares has been made by Beyer, Peacock & Company, Limited, Manchester. The consideration is one ordinary £1 Beyer, Peacock share for every 20 ordinary Anti-Attrition shares, plus 3d. cash for each Anti-Attrition share. The board of the company recommends acceptance of the offer.

JOHN HARPER & COMPANY, LIMITED, ironfounders, etc., of Willenhall (Staffs)—A final dividend of 20 per cent. makes 30 per cent. for the year ended March 31, 1957 (same). The profit is £259,064 (£194,563), less tax of £130,543 (£100,312). It is proposed to abolish preference rights attached to the unissued 100,000 redeemable £1 preference shares and to convert them into 400,000 ordinary 5s. shares.

FOSTER, YATES & THOM, LIMITED—Acceptances of the Hick, Hargreaves & Company, Limited, offer for the issued capital of the company have been received from over 85 per cent. of the shareholders. The offer is now declared unconditional, but the date for acceptance has been extended to July 13. The revised offer is one Hick, Hargreaves £1 share for every 10 5s. shares in the company plus 7s. 6d. cash per share.

METAL INDUSTRIES, LIMITED—A sharp recovery in profits in the year to March 31, 1957, has enabled the restoration of the 9 per cent. annual dividend with a 6 per cent. final. In view of the recovery and the fact that no payment was made on the ordinary for 1955-56, a special bonus of 5 per cent. is also recommended. Net profit, after tax, is £800,097, which compares with a loss of £420,256 in the previous year.

ALLIED IRONFOUNDERS, LIMITED—Trading profits fell by £177,525 to £2,287,434 after taking into account a loss of £268,000 sustained in the first year's operations of the Australian company. The dividend is 12½ per cent., against 13¾ per cent. The chairman states that since the war the company has spent over £5,000,000, almost entirely out of its own resources, and further substantial expenditure is planned during the next two or three years.

A. P. V. COMPANY, LIMITED—No dividend is being paid on the £1,250,000 ordinary capital of the company on account of 1956 operations, against 10 per cent. Group net profits were £121,906 (£101,328). Dr. R. J. S. Seligman, chairman, describes 1956 as a "disappointing year." Group turnover was not materially altered, but rising costs and falling profit margins resulted in a smaller profit.

Equipment & Supplies

Cyanide Poisoning First-aid Kit

Now that some founders' heat-treatment facilities include the use of cyanide baths, where there is a certain poison risk, interest will be shown in a new emergency first-aid kit by Cuxson, Gerrard & Company, Limited, Birmingham, for treating cyanide poisoning. Each kit is designed for the treatment of two patients, and includes "Ampins" of sodium nitrite and sodium thiosulphate solution, each being fitted with its own length of plastics tubing, drip chamber and flow control. This is claimed to speed the intravenous injection of these solutions, which are administered together with Nikethamide and Lobeline (for resuscitation) for the sodium nitrite-thiosulphate treatment of acute cyanide poisoning.

It should be noted that the kit does not replace the first-aid requirements as laid down by the Factory Form 385—Cyanide Poisoning, June 1953, under which amyl nitrate capsules and draughts of cyanide antidote must be held independently at the hazard site.

Portable, High-pressure Lubrication Pump

The latest addition to the range of lubrication equipment, manufactured by Centralube, Limited, Great Western Trading Estate, Park Royal Road, London, N.W.10, is the "Multigreasor," Model FAE. This has been designed as a portable unit for the rapid servicing of grease nipples at a pressure of 1,500 lb. per sq. in. The unit consists of a high-pressure pump connected to the grease gun by a flexible pressure-pipe, fitted with non-return valves and gauge, mounted on a four-wheeled trolley. The equipment is available in two sizes, with capacities of 25 and 30 lb. per hour, with pump-containers to hold 33 and 66 lb. of grease respectively; control is effected by means of a release lever located on the grease gun.

Safety Goggles

Protection of eyes in industry is always of importance—in foundries it is essential, for whereas a splinter of metal can be removed from the eye, it is impossible to erase a burn. Fleming Safety Goggles, a division of J. R. Fleming, Limited, 146, Clerkenwell Road, London, E.C.1, have introduced a new goggle to meet the requirements of the Iron and Steel Foundries Regulations. It is claimed that the use of Calobar-Infrex-D, toughened and green-tinted lenses provide adequate protection. Fig. 1 shows a pair of these that suffered considerable damage before fracture, of the glass in one eyepiece, occurred.

Bandsaw

Startrite Engineering Company, Limited, of Waterside works, Gads Hill, Gillingham, Kent, have introduced a new bandsaw, marketed under the trade name of "Volant," which is claimed to utilize the advantages of band machining, and to be able to shape metals, including castings, to a thickness of 5-in. The band speed is variable between 56 and 3,200 ft. per min., transmission being taken direct from the motor to a variable-speed gear box. A notable feature of the machine is the welding unit, which is fully automatic in operation and includes a motorized weld-grinder, blade-squaring shear and annealing control. This unit is claimed to be conveniently placed for "making up" band tools from coil stocks or rejoining a band after it has been run through a starting hole. Additional features claimed to assist in rapid throughput of jobs are the provision of a low-voltage spot lamp and air jet at the workstage; job selector dial, giving the operator all factors for most efficient operation; a 20 by 19 in. cast-iron work table swivelling through 50 deg. on a dual-trunnion casting; provision for a fence attachment; adjustable guide-pieces and transparent saw guard.

Cutting Oil

Amber Oils, Limited, 11a, Albermarle Street, London, W.1, have introduced an addition to their range of cutting oils, marketed under the name of Amber Straight, Sulfloid Light C.2. It is claimed that one of the company's customers found it was possible to increase the number of holes tapped, from 200 to 7,000, without tool regrinding. The oil contains a semi-coloidal sulphur addition, which remains in permanent suspension.

STEDALL & COMPANY, LIMITED, Broad Street House, 164 High Holborn, London, W.C.1, have been appointed sole sales agent for a new industrial metallic-mouldable paste, known as "Metolux," which has been developed by M. G. Plastics, Limited, of 19, Mincing Lane, Blackburn.

SKLENAR FURNACES, LIMITED, of Cardiff, have supplied to the Editor an illustration of one of a consignment of six of their furnaces recently despatched to Japan. These furnaces were sold through their agents Daiichi Bussan Kaisha Limited, of Tokyo, and now bring the number of this type of furnaces operating in that country to a grand total of 90 units. An interesting feature of these shipments has been that the furnaces have been sent out ready bricked and reports indicate that all such units have arrived safely, ready for immediate use by the purchasers. The firm's personnel from Cardiff have to date checked and demonstrated every unit installed in Japan, as in all other territories.

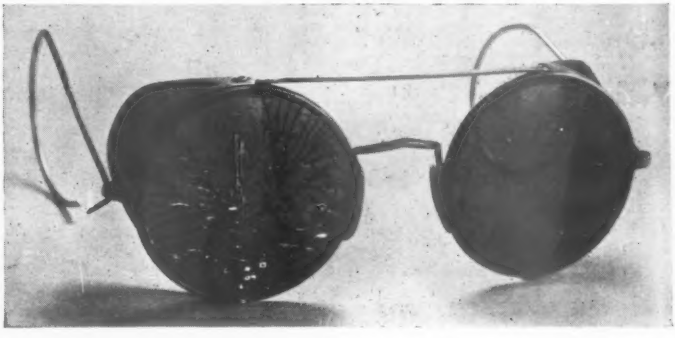


FIG. 1.—*Effect of considerable hot-metal splashing on a pair of lenses, at the foundry of British Steel Piling Company, Limited, manufactured by Fleming Safety Goggles, London. Even after fracture of one of lens, the toughened glass remained in position. Side protection is achieved by fine-mesh wire shields which effectively prevent the entry of metal particles or splashes coming from the side of the wearer.*

Metallurgical Progress

Some Researches of Particular or General Interest to Foundries

Use of Water-cooled Steel Moulds in Centrifugal Casting. N. JANCO. (*Steel.* 1956. Vol. 139; No. 26; pp. 72-3.) There has been a greater use of permanent moulds, whereby several castings can be made without doing any appreciable work on the mould. Most of these are made of graphite, cast iron or steel. The latest method involves the use of steel moulds with water cooling. Most castings, under 12 in. o.d., can be produced from heavy-walled steel tubing. Moulds from tubing can be made at low cost. With water cooling, the moulds are not removed from the machine after each casting; the casting is removed from the mould, so reducing handling costs. Where the usual maximum life of a graphite mould is about 100 castings, an iron mould can produce from 350 to 500, and a light-weight steel mould will give from 1,000 to 3,000 castings under the same conditions. Steel reduces the temperature differential between the inner and outer surfaces of the mould, which reduces stresses and increases the mould life. In some types of casting, the molten metal sticks or fuses to the wall of the mould; water cooling lessens this tendency.

Measurement of Gas Temperatures with Thermocouples. R. C. COREY. (*Combustion.* 1956. Vol. 28; No. 4; pp. 47-55) It is theoretically impossible to measure a gas temperature accurately unless the gas and its enclosure are at the same temperature. If there is a temperature difference between the gas and the walls of the enclosure, a thermocouple will be in error by an amount that depends upon the level of the higher temperature, the temperature difference, and the velocity of the gas passing the thermocouple junction. If the temperature of the gas is less than about 260 deg. C. and has a linear velocity from 50 to 300 ft. per sec., a bare thermocouple, suitably immersed in the gas stream, will be reasonably accurate for most purposes. For higher gas temperatures accompanied by gas-wall temperature differences greater than 10 deg. C., a high-velocity shielded thermocouple should be used to minimize the thermocouple temperature error. The multiple-type radiation shield is preferable, but a properly designed single shield will give satisfactory results up to a gas temperature of about 815 deg. C. The rate of aspiration should not be less than 3 lb. gas per sec. per sq. ft. of free cross-sectional area of the shield.

Experimental Determination of Oxygen in Cupola-melted Cast Iron. E. A. LORIA, H. W. LOWNE and M. W. MALLETT. (*Journal of Metals,* 1956. Vol. 8; No. 12; pp. 1,670-2.) Vacuum-fusion oxygen values are presented for cast iron melted in the Battelle 10-in. dia. cupola under normal operating practice. The nominal composition of the iron at the spout was 3.20 per cent. carbon and 2.10 per cent. silicon. Cupola slag and metal samples were taken simultaneously from five to seven taps spaced through each heat. The metal specimens for vacuum-fusion analysis were poured into split steel moulds. Individual vacuum-fusion results for oxygen, hydrogen, and nitrogen for each sample analysed are given. The results of cupola heats and vacuum-fusion analysis for oxygen agreed with de-oxidation theory as follow:—(1) The average amount of oxygen was about 0.002 per cent. (2) Changes in the silicon content of the iron from 1.32 to 2.35 per cent. had no consistent effect on the oxygen content of the iron. The oxygen content of the iron had no detectable relationship to either (*a*) the carbon content of the iron, within a range of 2.98 to 3.43 per cent., or (*b*) the carbon equivalent of the iron, within the range of 3.55 to 4.12 per cent. (3) Within a range of tapping temperatures from 1,455 to 1,539 deg. C. there was little change in the average oxygen content. For the limited range of oxygen contents, FeO contents in the slag had a wide range, from about 3 to 15 per cent. The reduction of FeO in the slag is not accompanied by any marked reduction in the oxygen content of the iron, and there is no consistent relationship between the FeO content of the slag and the oxygen dissolved in the iron.

Hardenability Factors for Hyper-eutectoid Low-alloy Steels. E. J. WHITTENBERGER, R. R. BURT and D. J. CARNEY. (*Journal of Metals.* 1956. Vol. 8; No. 2; Section 2; pp. 1008-16.) Hardenability factors for the elements carbon, manganese, silicon, chromium, nickel, and molybdenum have been developed for use with hyper-eutectoid low-alloy steels, in which bainite is the first sub-critical transformation product. The factors permit the prediction of 95, 80 and 50 per cent. martensite hardenability when quenching previously spheroidized steels from 802, 829, and 856 deg C. The especially strong contribution of silicon to the hardenability of high-carbon, low-alloy steels was found to be associated with its retardation of the bainite reaction. The important influence of both silicon and manganese upon hardenability suggests that increased amounts of these elements can be used to achieve additional hardenability in high-carbon, low-alloy steels.

Metal Whiskers. G. W. SEARS and S. S. BRENNER. (*Metal Progress.* 1956. Vol. 70; No. 5; pp. 85-9.) A tensile test was carried out on an iron whisker 4 by 10^{-9} sq. in. cross-sectional area and 0.1 in. long. The applied load, which was 0.1 oz., produced an elastic strain of almost 5 per cent., showing that the elastic strengths calculated for perfect crystals can be attained for actual crystals. The test was carried out in a special apparatus, the whisker being mounted at one end to a float containing a magnet. It was stressed by the application of a current to a solenoid which pulled the float towards the centre of the solenoid. The strain and the stress were measured by observing the change in distance between two fiducial marks on the whisker. One of the methods of whisker growth is the chemical reduction of metal salts, such as the halides. The halide vapour is brought into a hot furnace where

Metallurgical Progress

it decomposes. Iron whiskers grow in great profusion by this method. Experiments making use of the great strength of whiskers (the pure annealed iron specimen withstood 1,900,000 lb. per sq. in. before fracture) can be most interesting. Several per cent. of elastic strain has a marked effect on the metal lattice, changing its crystallographic symmetry and probably affecting its electrical resistance, magnetic properties, and chemical properties. The main disadvantage for many applications is the extremely small size of the whiskers. Although they can be grown a few inches in length and 0.010 in. thick, the strength decreases with increase in size. The research applications of whiskers are numerous. They may be useful in experiments requiring relatively pure single crystals of known orientations. The preparation of single crystals of iron by ordinary methods is much more difficult.

Low-Manganese Steels for Nuclear Applications. H. F. BEEGHLY. (*Journal of Metals*, 1956. Vol. 8; No. 12; pp. 1,664-70.) Experimental carbon steels made with no manganese addition and residual manganese contents of the order of 0.10 to 0.15 per cent. have been made by the basic open-hearth process and rolled into plate, bars and seamless tubing. These products when tested by ASTM methods met the mechanical-property requirements for comparable grades with normal manganese contents. Elevated temperature, *i.e.* short time, tensile tests were made over the range from room temperature to 705 deg. C. The low-manganese material is superior to the normal manganese steels, and as good as the 0.5 per cent. molybdenum steel. The elevated-temperature tensile data show the low-manganese steels to be free from strain ageing. Weldability tests were made by joining the low-manganese steels to commercial A.212 plate and to stainless steel of the 347 (columbium stabilized) and 304-type. Welds were made with the coated metal-arc and inert-gas shielded tungsten arc processes. The material welded satisfactorily in all cases with no evidence of porosity or cracking. All data, including X-ray examination, indicated that the low-manganese materials welded as well as, or better than, commercial normal manganese grades.

US Steel Prices Increased

Because of increases in wages and benefits which became effective for many of its employees on July 1, the United States Steel Corporation has increased its prices by approximately $6 a ton.

This announcement was followed by an intimation by the Steel Company, Canada, Limited, that its steel prices would be increased by $5 per ton on most types from July 1. Other US companies have taken similar action to that of the United States Steel Corporation.

Operations at steel mills in the United States last week were scheduled at 79.1 per cent. of rated capacity, with production at 2,024,000 tons. This compares with the previous week's 84.0 per cent. and 2,150,000 tons.

The ingot index was 126.0 per cent., compared with 133.8 per cent. a week earlier. The index is based on average 1947-49 output inclusive, which was 83,837,572 net tons.

Whitehead Iron Profit Forecast

An improving order-book and confidence that the Iron and Steel Board will revise the scale of prices and profit margins in favour of re-rollers and cold rollers to a scale which gives them a reasonable return on the capital employed in the business are reasons advanced by the directors of the Whitehead Iron & Steel Company, Limited, in support of their declared belief of a recovery in the company's finances after the end of the financial year.

The interim dividend in respect of the year ending September 30 is maintained at 10 per cent. despite a fall in group profits, before tax, from £789,760 to £426,948 for the six months ended March 30.

Demand for cold-rolled strip from the motor-car and associated industries and from certain other consumers affected by the "credit squeeze" and hire purchase restrictions receded during the period and there was a reduction in earnings as a result of the sale of W. A. Baker & Company pending re-employment of the proceeds on a satisfactorily remunerative basis. A narrowing of profit margins due to increased production costs was not compensated by a corresponding rise in permitted selling prices, the directors add.

Metal Box faces "Challenge"

Increased trading profits by the overseas group of the Metal Box Company, Limited, have offset a reduction in those of the home group for the year ended March 31 last, states the chairman, Sir Robert Barlow, in his annual review. A further rise in sales in the open-top and general line products groups is envisaged in the current year.

Sir Robert adds that no doubt costs and expenses would continue to rise, but improved efficiencies should combat those trends. The Steel Company of Wales, Limited, in which Metal Box has taken 1,000,000 ordinary shares, had its new tinplate plant at Velindre in action and the supply of good plate was assured for a year or two. This would economize on costly imports, but the price was continually rising, at a time when the prices of its main competitors as a packaging material—paper, board, and plastics—were "either stationary or likely to fall substantially. The use of tinplate will be seriously challenged by these alternatives," says Sir Robert.

Sales were increased by 12 per cent. to a record of £68,687,000. The net group profit is £2,945,756 (£3,005,413) and the ordinary dividend is 11 (10) per cent.

No BIF at Birmingham Next Year?

As it considers that the time available is not sufficient to stage an international fair, the Birmingham Chamber of Commerce has decided not to hold a British Industries Fair in 1958. A deputation from the chamber met the President of the Board of Trade, Sir David Eccles, on June 27.

Sir David said that in his view the question of "internationalization" in future years must depend primarily on the attitude of British industry. Sir Hugh Beaver, president of the Federation of British Industries, is to make further inquiries on this point and it has been agreed to hold another meeting to discuss the matter.

Foundry Equipment Sales

According to the Board of Trade, the foundry equipment industry, during the first quarter of this year, exported £303,000 of goods and in the home market sold further goods to the value of £1,072,000. The breakdown of these figures is set out in Table I.

Table I—Summary of Returns made to the Board of Trade by Firms Manufacturing Foundry Equipment (No. of Returns 49) (figures×£1000)

Type of equipment.	Deliveries during Jan. to March, 1957		
	For export.	For other orders.	Total.
Sand preparing machines (*i.e.*, mills, disintegrators, etc.)	93	234	327
Moulding machines and moulding boxes	123	244	367
Sand-blast plant	34	255	289
Melting equipment (including ladles) ..	17	94	112
Coremaking machines, plant and accessories	19	48	67
Other equipment including chaplets and studs, but excluding mechanical handling plant or mechanization and materials such as abrasives, etc. ..	17	196	213
TOTAL	303	1,072	1,375

NOTES.

Goods which are only merchanted or factored are excluded.

The figures in the columns:—

"*For export*" include only direct exports and supplies known to be destined for export through merchants or shipping houses.

"*For other orders*" include supplies to Government Departments, local authorities, the National Coal Board, British Railways and other public utility undertakings, the Channel Islands and general home trade.

The figures have been rounded off to the nearest final digit and there may be an apparent slight discrepancy between the sums of the constituent items and the totals shown.

From this table it is possible to state that the home market sales were above the average for last year, whilst exports were below the 1956 mean figures.

Electronic Computer Exhibition, 1958

Prospective exhibitors in the Electronic Computer Exhibition which is to be held at Olympia, London, from November 28 to December 4, 1958, are now being asked to confirm their space requirements. The exhibition, which is to be the first of its kind in Great Britain, is being sponsored by a joint committee of the Radio Communication and Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association. Arrangements are well advanced for an international technical symposium, organized by the National Physical Laboratory, to be held in conjunction with the exhibition and a business computer symposium organized by the joint exhibition committee of the two associations. The exhibition is non-profit making, and any excess of receipts over expenditure is to be returned to exhibitors.

THE NETHERLANDS PRODUCTION of iron castings in 1955 was of the order of 155,000, whilst last year, during the last nine months, it increased to 164,000 tons—which presages to an annual output of 200,000 tons.

JOHN LAWRENCE & COMPANY (DOVER), LIMITED, brass founders, Charlton Green, Dover, Kent, are planning the erection of proposed new works premises on a site at Granville Street and Churchill Street, Dover.

Notes from the Branches

South Africa

A second programme booklet has been issued by the South African branch of the Institute of British Foundrymen containing details of activities for the period July to December, 1957. It lists the following forthcoming lectures:—July 25: "Practical Aspects of Abrasive Cleaning in the Foundry," by Mr. J. F. Attwell; August 22: "Swarf Injection in the Cupola," by Mr. S. H. Shrobok; September 19: "Epoxy Resins for Patternmaking," by Mr. K. H. Coombs, Mr. D. Jepson, and Mr. M. van de Wende; October 24: Discussion—"Is Laboratory Control of Sands Essential?", and November 28: "Non-ferrous Foundry Practice," by Mr. S. Webster. During August (exact date not specified) there will be a works visit to SAFIM, Vereeniging, S.A., manufacturers of agricultural implements. A list of members and officers of the branch is included, as is also a map showing the location of the new venue of the branch for the next six months—the National Cash Register Building in Johannesburg.

Annual Report

Also published in the booklet is the financial statement and annual report for the year 1956/57, a year which has been a very active one for the branch, with ten lectures and three works visits. During the year, 58 new members in all grades were added to the branch membership, and there were 23 transfers to higher grades of members and six transfers from overseas branches. The report states that a poster has been prepared to advertise the Institute and publicize branch activities. This poster is now on display in a large number of foundries in the Union and Central African Federation. Advance notification of branch activities is also being published in several South African technical journals and a national newspaper.

Twenty-first Anniversary

In February, 1958, the branch celebrates its 21st anniversary, and for this occasion the following events have been arranged. An exhibition will be held for three weeks in the Johannesburg Public Library; present-day trends in foundry practice will be depicted, and a display of castings in use in every-day life will be included. An all-day conference covering a wide range of foundry subjects; a broadcast on the importance of castings in every-day life; film shows and works visits are also included. The main social event will be the anniversary banquet.

Sands Research

During the year under review, the foundry sands research committee made arrangements with the Council for Scientific and Industrial Research to establish and investigation to determine the availability and suitability of South African sands for foundry practice. To this end, the foundries have been invited to sponsor a Fellowship for a period of three years to conduct the necessary research.

Electricity from Gas

An innovation at the Bath and West Agricultural Show, held recently in Swindon, was the installation of a dual-fuel engine, demonstrating the potentialities of securing an electricity supply from gas. The unit comprised a Lister-Blackstone six-cylinder diesel/gas engine, type EVDF6, coupled to an ECC alternator, the gas supply for this being obtained from the town's-gas main and resulted in an output of 150 kw. With diesel fuel, the comparative output would have been in the order of 185 kw.

News in Brief

THE NON-FERROUS CLUB held its first annual golf tournament at the Stratford-on-Avon Golf Club on Wednesday, June 26.

FOR THE FIRST time the annual regional conference of the Institute of Industrial Supervisors was held in Coventry, on June 22.

THE ROUTEMASTER, a product of Leyland Motors Limited, next month goes into service in London as a unit of the Green Line system.

THE EMPLOYEES of Precision Presswork Company, Limited, were the guests of the firm for a day's visit to Blackpool, on Saturday, June 29.

IMPERIAL CHEMICAL INDUSTRIES, LIMITED, are making a contribution of £19,900, over the next four years, to Hull University, for a chemistry building and library.

A RECENT DECISION by the Reading magistrates, ruled that a dumper using the public highway must carry a third party insurance if a passenger was being carried.

APPROXIMATELY 600 EMPLOYEES, of Hale & Hale (Tipton) Limited, together with their families journeyed to London for their annual outing, accompanied by the management, on Saturday, June 29.

WILLIAM BEARDMORE AND COMPANY, LIMITED, steel manufacturers, Parkhead Forge, Glasgow, E.1, has had plans approved to erect a melting shop, transformer and control house at Duke Street, Glasgow, E.1.

THE EXPORT CREDITS GUARANTEE DEPARTMENT has resumed cover on all forms of short-, extended-, and medium-term credit business with Israel. Cover was restricted last November to Letter of Credit business.

A MAN WAS KILLED and six others injured in an accident with a 4-ton slag ladle early on July 1 at the Templeborough melting shop of the Steel, Peech & Tozer branch of the United Steel Companies, Limited, Rotherham.

THE SOKE OF PETERBOROUGH County Council, Planning Committee, has given permission to G. W. S. Burdett & Company, Limited, engineers, of Eastgate, Peterborough, for the erection of a new foundry building in Padholme Road.

A BLOCK OF NEW, modern showers and baths for foundry workers was opened at Bryan Donkin Company, Limited, of Chesterfield, on June 27. The opening ceremony was performed by Mr. Alexander Abel-Smith, vice-chairman of the company.

THE TYNE IMPROVEMENT COMMISSION is to carry out test borings and piling work in connection with proposed extensions to the Tyne Dock iron-ore discharging quay. Further dredging operations are proposed at the ore quay to enable it to accommodate two 29,000-ton vessels.

THE ORIGINAL SILVER GHOST, built in 1907 was included in an exhibition of Rolls-Royce products on show at the premises of P. J. Evans Limited, Birmingham. The exhibition was officially opened by Mr. F. Llewellyn Smith, managing director of the Motor Car Division of the company, on June 25.

AT THE RUSTLESS IRON COMPANY, LIMITED, Lawkholme Lane, Keighley, recently, an overhead crane fell from its rails, striking a 56-year-old labourer, Richard Hughes, who was taken by ambulance to Keighley and District Victoria Hospital, where he was found to be dead on arrival.

A 12-ACRE SITE at Coolkeeragh, nearly four miles from Londonderry, Northern Ireland, and on the shores of the River Foyle, is now being cleared for the construction of a £4,500,000 power station which will complete the Electricity Board's circuit of Northern Ireland. Construction of the station is expected to begin in the autumn.

SEVEN MONTHS after his fourth visit to Canada in two years, Mr. W. A. Hartop, works director of George Kent, Limited, left London, last Saturday, on the first stage of a round-the-world tour, the main object of which is to stimulate and expand the firm's export markets. Altogether he will spend about four months with the Kent organization in four Commonwealth countries.

TEST BORINGS are being undertaken by the Central Electricity Authority on the probable sites for another two atomic-power stations. The sites are at an undeveloped part of the south coast of Kent, near Dungeness, and on the west coast of Wales, between Aberystwyth and Penrhyndeudraeth. It is hoped that planning permission will be received, in time for work to commence on both schemes early in 1958.

CHAMBERLAIN INDUSTRIES, LIMITED, of Staffa Works, Staffa Road, Leyton, London, E.10 (one of the Chamberlain group of companies) announce that they have appointed Hailes Plant Sales & Hire, Limited, of 81, Great King Street, Edinburgh 3, and Royal Exchange Buildings, Glasgow, C.2, as their Scottish distributors to handle the sales of both the Jenbach diesel air-compressor and the Staffa range of mobile and shop cranes.

AFTER AN INTERVAL of several years, during which the market has been virtually closed because of import restrictions, Lane & Girvan, Limited, ironfounders, Bonnybridge, Stirlingshire, have received an order from the Argentine for 100 wood-burning stoves. The stoves, which will go to various parts of the Argentine, form the third substantial order the firm have received from South America this year. The two previous orders were for similar stoves for Chile.

A LICENCE AGREEMENT has been concluded between Vickers-Armstrongs (Engineers), Limited, and Sulzer Bros., Limited, Winterthur, Switzerland, for the manufacture of Sulzer marine diesel engines up to 24,000 b.h.p. The agreement also enables associates of the licensees—Cockatoo Docks & Engineering Company, Limited, Sydney, and Canadian Vickers, Limited, Montreal—to build Sulzer engines under licence.

PHILIPS ELECTRICAL, LIMITED, Century House, Shaftsbury Avenue, London, W.C.2, announce the introduction of a radiation protection service which will be operated by the company's Research & Control Instruments Division. This service offers consultation on X-radiation protection problems, without cost or obligation. It also provides for the planning and equipping of complete X-ray departments with all necessary protective measures, as well as the revision of such measures in existing departments.

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH announce that the documents section of the Technical Information and Documents Unit (TIDU) has now been merged with the Lending Library Unit and will operate from 20, Chester Terrace, Regents Park, London, N.W.1. All future requests for the loan of documents, referred to in TIDU unpublished-report summaries and requests for photoreproductions of reports and German documents, should be sent to the new address. Documents which were issued on loan by TIDU from Cunard Building should be returned to this address.

Personal

Mr. B. B. ARGENT has been appointed lecturer in metallurgy at Sheffield University.

Mr. B. E. WHEADON, formerly chief technical representative, has been appointed technical sales manager of Desoutter Bros., Limited, pneumatic and electrical tool manufacturers, of London, N.W.9.

Mr. ALEXANDER L. MCLAREN has been appointed London manager of Bertrams, Limited, general engineers and ironfounders, of Edinburgh, in succession to Mr. JOHN D. KIDD, who has been appointed technical director.

Mr. ALEXANDER BELCH has been appointed to the boards of H. Widdop & Company, Limited, and the Free Piston Engine Company, Limited. Both companies are subsidiaries of Associated British Engineering, Limited.

Mr. WILLIAM ELLIOT, foreman joiner of Clelands (Successors), Limited, engineers and shiprepairers, of Wallsend, has received presentations on his retirement after 47 years' service with the company and its predecessors.

Mr. ALFRED RICHARDSON, O.B.E., deputy public relations adviser to the Prime Minister, has been appointed chief information officer, Ministry of Labour and National Service, in succession to Mr. LEX HORNSBY, C.B.E.

Mr. DOUGLAS BROWN, who is to join Black & Decker, Limited, manufacturers of portable electric tools, of West Drayton (Middx), as contracts sales manager in August, is at present technical director of Attwood Statistics, Limited.

Mr. R. J. SHORTTLE, mill manager at the Redcar works of Dorman Long & Company, Limited, for 12 years, has taken up a post at the firm's Britannia works, Middlesbrough, and has received a presentation from the men at Redcar.

Mr. WILLIAM BAKER, who had been Midlands area manager at Birmingham of Herbert Morris, Limited, lifting and transporting machinery manufacturers, of Loughborough (Leics), since 1919, has retired after 43 years' service with the company.

Mr. JOHN WILLIAM MILLS, O.B.E., M.I.MECH.E., for over 12 years a director of Armstrong Whitworth (Metal Industries), Limited, and Jarrow Metal Industries, Limited, has decided to relinquish his seat on the board, in order to reduce his business commitments.

Modern Furnaces & Stoves, Limited, Booth Street, Handsworth, Birmingham 21, announce that Mr. J. N. TAYLOR has been elected chairman and director, in succession to the late Mr. A. E. Griffiths. Mr. J. L. GOODWILL and Mr. T. C. SHARPE remain as joint-managing directors.

Mr. H. A. LUSS has been appointed chairman of the nucleonics group of the Scientific Instrument Manufacturers Association. Mr. Luss, who is at present joint managing director of Isotopes Developments, Limited, has also been appointed deputy chairman of that company.

After being connected with ironfounding for over 56 years, Mr. HAROLD HAYNES has retired, giving up his position as foundry manager of the National Gas and Oil Engine Company, Limited, Ashton, which he has held since 1943. He has held many honorary offices in connection with "National," being secretary of the Canteen Committee and a past-president of the Social Club. A long record of service to the Institute of British Foundrymen is marked by presidency of the Lancashire branch, awards of the Institute's Diploma, and the Meritorious Services medal and membership of the General Council. He is also a member of the Advisory Committee of the City & Guilds examining board for foundrywork and patternmaking. He is the author of a number of papers on foundry practice delivered at meetings all over the British Isles. On his retirement from the firm, he was the recipient of a reclining chair and shaving set from the staff, a "travelling" alarm-clock, umbrella and flower-holder from the moulders, coremakers and dressers in the foundry and a pipe and tobacco from the girls in the coreshop.

Obituary

Mr. ERNEST GEORGE WHITEHEAD, a director of the Wolverhampton Die Casting Company, Limited, has died at the age of 67.

Mr. COLLINGWOOD HORSLEY, who for many years was associated with the old Horsley's ironfoundry at North Shields, has died at the age of 78.

Mr. ALBERT EDWARD SLINGSBY, founder with his brother of G. & A. E. Slingsby, Limited, tube and valve manufacturers, of Hull, has died at the age of 83.

Mr. ERNEST TEASDALE, who was former assistant traffic manager for the Consett Iron Company, Limited, Consett (Co. Durham), has died at the age of 86.

Mr. STANLEY DALE, a partner in the family firm of J. W. Dale & Son, consulting marine engineers and ship surveyors, of North Shields, died on July 2 at the age of 46.

Mr. DONALD MARSH STUBBS, for many years a partner in W. B. Stubbs & Son, hand truck and trolley manufacturers, etc., of Hawksworth (Notts), has died at the age of 64.

Mr. GEORGE M. WILSON, who until his retirement last year was cashier for the Brightside Foundry & Engineering Company, Limited, Ecclesfield, Sheffield, has died at the age of 66.

Mr. CHARLES B. WOOD, who, until his retirement several years ago, was works manager at Newton, Chambers & Company, Limited, Thorncliffe, near Sheffield, has died at the age of 81.

Mr. EDWARD RONALD BRIGHAM, joint managing director of Brigham & Cowan, Limited, engineers and shiprepairers, of South Shields, has died at the age of 59. He had been associated with the firm for some 40 years.

The death has occurred, at the age of 71, of Mr. WALTER HULME, who was managing director of Morrison, Ingram & Company, Limited, brass and iron founders and sanitary engineers, of Cornbrook, Manchester.

Mr. JAMES GRIMOND FITZGERALD, founder of J. G. Fitzgerald, Limited, metal and engineers' agents, of London, N.1, has died at the age of 56. Before starting his own engineering agency he served as London manager for Sanderson Bros. & Newbould, Limited, steelmakers, etc., of Sheffield.

The death has occurred at the age of 84 of LORD RIVERDALE, well-known Sheffield industrialist, chairman of Arthur Balfour & Company, Limited. He was especially prominent for his work in connection with the establishment and activities of the Department of Scientific and Industrial Research and, since 1948, has been president of the Production Engineering Research Association.

Raw Material Markets

Iron and Steel

The effect of last week's increases in coal prices has been to advance the price of Durham foundry coke by 15s. 9d. per ton and of Welsh foundry coke by 14s. 10d. per ton. Hard furnace coke, is also increased by 10s. per ton. From July 1 blast-furnace coke also was increased by the same amount as foundry coke, and with the continued rising costs of production, which were not all absorbed in the last increase in December, 1956, a further revision of steel and pig-iron prices appears to be imminent. The ironfoundries are also facing regular rises in production costs, and although they have absorbed some of these increases in the past, they are unable to continue this procedure indefinitely.

Basic steelmaking pig-iron continues in heavy demand, and outputs are readily accepted by the steelworks, which are now receiving supplies more in keeping with requirements. The engineering foundries keep up their increased demand for hematite and low-phosphorus irons, and the foundries supplying castings to the motor vehicle industry are increasing their outputs. Hematite makers are able to satisfy demands, but in some areas the supply of the low-phosphorus irons is becoming more difficult with the call for increased supplies. In the last week or so there has been some improvement in the demands for high-phosphorus pig-iron, chiefly to replace depleted stocks at the foundries. Adequate supplies are available. It is understood that a limited amount of hematite pig-iron, which has not been available for export, is now being allowed for shipment and that increased tonnages of high-phosphorus pig-iron are also likely to be exported.

The foundries are taking up arisings of best cast-iron and machinery scrap, but disposal of the lighter and medium grades is more difficult. Foundry coke is plentiful, apart from some Welsh grades. Ganister, limestone, and firebricks are freely available.

Orders on hand at the re-rollers are enabling them to maintain fairly good outputs of small bars, light sections, etc. Regular demands are forthcoming from stockholders and consumers. These are not so heavy as before, so that improved deliveries are being given. Reinforcing rods are still under pressure, and demands are heavy. Sheet and strip re-rollers continue to benefit from the improved demands from the motor-car trades. Adequate supplies of steel semis are on hand and home steelworks are maintaining their improved rate of delivery. Many of the re-rollers have good stocks of steel, this being the result of the increased tonnages which have been received from abroad.

Non-ferrous Metals

The price reductions last week—the RST price was reduced £10 to £220 a ton and the US custom smelter price was lowered to 28½ cents a pound—caused further weakness in the London copper market. But this was quickly reversed on the news, or, rather, unconfirmed rumour, that the Chilean authorities were contemplating a 10 per cent. reduction in copper output from the US-owned copper companies. Why the London price firmed up so quickly and, incidentally, the copper shares on the Stock Exchange, is difficult to understand. For, apart from the fact that the news is not official, any cut-back would not begin to make itself felt for at least three months. Furthermore, although there have been other production cut-backs supplies are still in excess of consumption and with several countries having to make cuts in their import programmes the near-term outlook is not bright. On the other hand, fabricators have undoubtedly eaten into their stocks and the revival of demand—now expected in the autumn—if it does materialize could find the supply position too thin to withstand sustained buying to meet consumer requirements and replenish depleted inventories. In that case the price of the metal may well advance steeply. In London stocks are over 10,000 tons and a larger contango can be expected.

Tin remains quiet, but reasonably steady, on both sides of the Atlantic, a feature largely attributed to both the actual and potential buying power of the buffer stock. The May shipments from Indonesia indicate that despite political upheavals in that country the tin industry is managing to carry on as before.

Lead is not a strong market in either London or New York. In America the feeling is growing that the present price of 14 cents a pound cannot be maintained and this has naturally led to cautious buying. However, labour troubles among US producers and Belgian fabricators, together with cut-backs in production, have helped to impart a steadier tone to the market than would otherwise be possible through the normal course of demand.

Zinc is still unsteady and, although the general US price is considered to be 10 cents a pound, only one leading custom smelter officially acknowledges this quotation. The heavy fall in the zinc price has already caused several US mines to close down and it is now making difficult the signing of new wage contracts in a number of places. The ensuing strikes, together with those in Belgium, have helped to steady the market, but production as yet is still outrunning supplies.

Railway Freight Charges Increased

Because of further heavy increases in working costs, British Railways' charges for freight traffic (except small consignments by goods train chargeable at the recently published scales) will be increased by 10 per cent. as from August 1. To enable this to be fully effective the British Transport Commission proposes to make use of the special statutory procedure for temporary authorization of an increase in the maximum charges fixed by the railway merchandise charges scheme.

The last increases in railway freight charges came into effect on April 23, 1956, and the increases actually applied then were considerably lower than those which the Commission had originally proposed. Since that time, the Commission's working costs have risen by the equivalent of some £40,000,000 in a full year, due to increases in the price of coal, in wages and salaries, and in the prices of other items such as steel, road fuel, and tyres. Of this total rise in costs of £40,000,000, some £30,000,000 are applicable to British Railways. The Commission has applied to the Minister of Transport and Civil Aviation for authority to increase charges for docks and inland waterways by 5 per cent., and the Minister, after consulting the Transport Tribunal, has approved an application for increased charges and is making regulations accordingly.

GEORGE FLETCHER & COMPANY, LIMITED, engineers of Derby, have just completed two cane mills, for Lakshmiwadi, India, which will be used in a large sugar-making plant. Powered by steam turbine, the mills cost approximately £60,000.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 10, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 10d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 1d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3½d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 22s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

* Average 68-70 per cent.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £65 2s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £65 10s. 3d., nickel-chrome, £92 13s. 0d.; nickel-chrome-molybdenum; £104 11s. 6d.

NON-FERROUS METALS

Copper.—Cash, £218 15s. 0d. to £219 0s. 0d.; three months, £220 15s. 0d. to £221 0s. 0d.; settlement, £219 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 1½d. per lb.; rods, 253s. 0d. per cwt. basis; 20 s.w.g., 286s. 3d. per cwt.

Tin.—Cash, £755 0s. 0d. to £757 0s. 0d.; three months, £753 10s. 0d. to £754 0s. 0d.; settlement, £757 0s. 0d.

Lead (Refined Pig).—First half July, £90 10s. 0d. to £91 0s. 0d.; first half October, £91 0s. 0d. to £91 5s. 0d.

Zinc.—First half July, £76 15s. 0d. to £77 0s. 0d.; first half October, £74 0s. 0d. to £74 5s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £110 15s. 0d.; rolled zinc (boiler plates), all English destinations, £108 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 9½d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 187s. 0d. per cwt.; wire, 2s. 7⅝d.; rolled metal, 187s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £150; B6 (85/15), £154; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £203; HTB2 (38 tons), — ; HTB3 (48 tons), £225.

Gunmetal.—BS1400, LG2 (85/5/5/5), £196; LG3 (86/7/5/2), £205; G1 (88/10/2/½), £263; (88/10/2/1), £255.

Phosphor Bronze.—BS1400, PB1 (AID released), £284 per ton.

Phosphor Bronze Strip, etc.—Strip, 272s. 6d. per cwt.; sheets to 10 w.g., 287s. 0d. per cwt.; wire, 3s. 10½d. per lb.; rods, 3s. 2½d ; tubes, 3s. 2½d.; chill cast bars: solids 3s. 2d., cored 3s. 3d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 8d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £90 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £245; AB2, £255.